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Monthly Message

Many times it has been said that somewhere in the writings of Lenin there is a statement that it will be easier and more effective to bankrupt the United States through economic measures than through a hot war. In order to verify this rather loose quotation, I wrote to Mr. L. Quincy Mumford, Librarian of the Library of Congress, to ask if it were true. He replied that, "The Library staff has been asked on many occasions to verify a statement attributed to Lenin about driving the United States into bankruptcy." They have never been able to find such a statement.

"The closest reference we found is a passage in Lord John Maynard Keynes' book, *The Economic Consequences of the Peace* (Harcourt, Brace & Company, New York, N. Y., 1920), pp. 235-236, which reads:

> Lenin is said to have declared that the best way to destroy the Capitalist System was to debauch the currency. By a continuing process of inflation, governments can confiscate, secretly and unobserved, an important part of the wealth of their citizens. By this method they not only confiscate, but they confiscate *arbitrarily;* and, while the process impoverishes many, it actually enriches some. The sight of this arbitrary rearrangement of riches strikes not only at security, but at confidence in the equity of the existing distribution of wealth. Those to whom the system brings windfalls, beyond their deserts and even beyond their expectations or desires, become "profiteers," who are the object of the hatred of the bourgeoisie, whom the inflationism has impoverished, not less than of the proletariat. As the inflation proceeds and the real value of the currency fluctuates wildly from month to month, all permanent relations between debtors and creditors, which form the ultimate foundation of capitalism, become so utterly disordered as to be almost meaningless; and the process of wealth-getting degenerates into a gamble and a lottery. Lenin was certainly right."

In this statement again there appears the common "Lenin is said" type of quotation, and the last sentence in Lord Keynes' paragraph implies acceptance of the truth of the statement.

Frank B. Berry

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A GONIOMETRIC STUDY OF THE HUMAN FOOT IN STANDING AND WALKING

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DESPITE modern advances in transportation and communication, travel by foot is often the only means of getting military forces to their destination. The constant improvement in footgear seems to be unable to compensate for the great demands imposed on the feet, as evidenced by the frequency and multiplicity of foot disorders. It is obvious that study of the mechanics of the foot is indicated so that measures for prevention of these disorders may be found.

The objective of the present investigation was to study changes in the amount of pronation and supination of the foot under various conditions during standing and during walking. Inasmuch as a previous investigation had shown that the extent of pronation and supination can be found by measuring the angle formed by the lower leg and calcaneus (Angle C, fig. 1), angle C was utilized in the present study.

This report consists of two parts. The first deals with the foot in standing and the second with the foot in walking. In the first part, the foot in standing, angle C was measured in order to determine: (1) the effect of functional insoles as compared with conventional insoles; (2) the effect of distance between the feet; (3) the effect of body weight distribution; (4) the effect of heel height; and (5) the validity of the manual goniometer for measuring angle C. In the second part, the foot in walking,

From Department of Physiology, Springfield College, Springfield, Mass. This work was supported by a grant from the Research and Development Division, Office of the Surgeon General, Department of the Army, Washington, D. C.

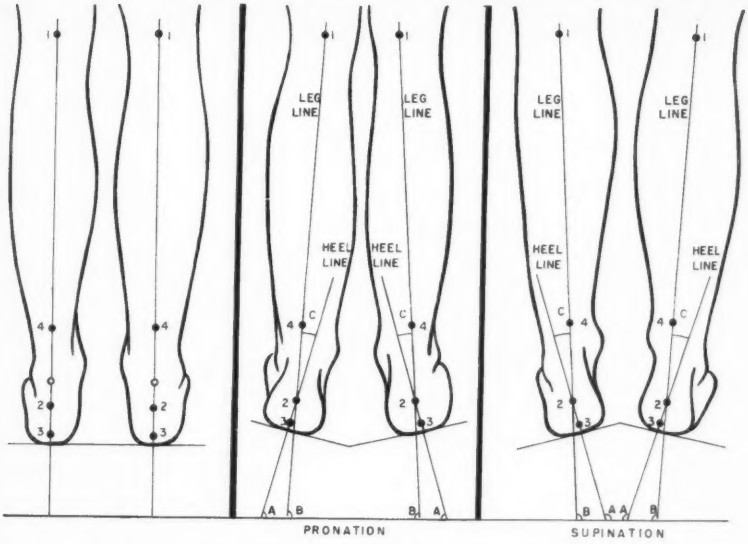

Figure 1. Skin marks on the leg, and angle C. (1) Mid-popliteal points. (2) Mid-talocalcaneal points. (3) Mid-heel points. (4) Upper Achilles points. In pronation ∠C=∠B−∠A, in supination ∠C=∠A−∠B.

angle C was automatically measured and recorded by a new device called an electrogoniometer.

THE FOOT IN STANDING

MATERIALS AND METHODS

The subjects were college students with normal feet.

Leg marking is illustrated in figure 2. The subject stood with feet parallel to each other. The medial condyle of the tibia and the head of the fibula were found. Using sliding calipers, the mid-popliteal point was found. A T-square was then placed horizontally at the lowest point of the medial maleolus and a mark was made on the middle of the tendon of Achilles, the mid-Achilles mark. To assure the horizontality of the square, a round spirit level was attached to this device (fig. 2, I). A line extending to the base of the heel was drawn through these points. Two more marks also were made: the mid-heel, 1 inch above the ground, and the talocalcaneal, midway between the mid-Achilles and the mid-heel.

An inclinator, an apparatus for changing the degree of pronation or supination in a standing subject, was used. It consists of two platforms hinged together in the middle, a jack under the hinge, and a protractor. By operating the jack, the middle

may be lowered or raised, changing the angle formed by the platforms.

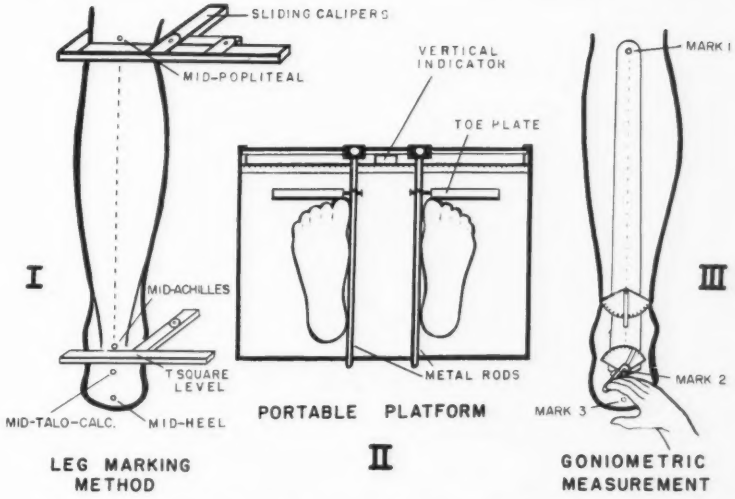

Figure 2. Leg marking method, portable platform and manual goniometer.

The portable platform (fig. 2 II) had two metal rods which could slide sideways and were used to keep the feet parallel, and toe plates which could slide anteroposteriorly and serve as stops for the big toes. A straight ruler was attached to the middle of the platform and served as an indicator of the verticality.

As in a previous study,[1] legs of the subject were appropriately marked and photographed. The angle C was measured on these photographs.

Footgear had been made with transparent plastic uppers so that the markings on the skin could be photographed. Low quarter shoes and combat army boots with standard outsoles and also with Hack ripple outsoles were used. One half of each type of footgear had conventional insoles and the other half had functional insoles. A functional insole was made from a conventional one by placing inside the shoe a wedge-like, plastic insert over the medial half of the heel. There were, therefore, altogether six subtypes of footgear, loaned for this study by the Quartermaster Research and Engineering Center, Natick, Mass.:

1. Low quarter, conventional insole (LQc)
2. Low quarter, functional insole (LQf)
3. Boots, standard outsole, conventional insole (Sc)

4. Boots, standard outsole, functional insole (Sf)
5. Boots, Hack outsole,* conventional insole (Hc)
6. Boots, Hack outsole, functional insole (Hf)

The manual goniometer (fig. 3) designed for this study was made of transparent plastic. It consisted of two shafts and a protractor. The operator placed this instrument on the back of

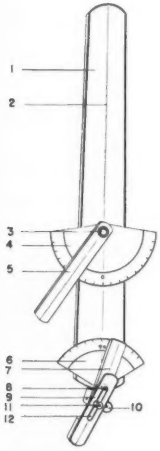

Figure 3. Manual goniometer. (1) Long shaft. (2) Center line. (3) Ball bearing. (4) Protractor. (5) Verticality indicator. (6) Protractor. (7) Angle C indicator. (8) Swivel joint. (9) Adjustable arm. (10 and 11) Winged screws. (12) Slot for adjustable arm. The long shaft is 16 inches long, 3/4 inch wide at the upper end, and 1¼ inches at the lower end. The protractor is 3 inches in diameter.

the subject's leg so that the longer shaft was on the leg line, the shorter shaft on the heel line, and the center of the protractor on the talocalcaneal joint (fig. 2, III). The operator read angle C directly from the protractor. Above the protractor there was a free-swinging indicator showing the degree of deviation of the long shaft from the plumb line.

RESULTS

Comparison of the supinating effect of conventional and functional insoles. The subject stood on the inclinator so that each foot was supported by a separate plane inclined toward the middle line, forming a letter V, thus forcing pronation of the feet. The angles formed by these planes with the horizontal were equal and set at 0, 5°, 10°, 15°, and 20°. Nine subjects were used, barefoot and wearing the six subtypes of footgear.

The photographic method of recording and measuring angle C was used. The data and the results of the three-way analysis of variance are given in table 1. The differences between means or angles C obtained with subjects wearing footgear or barefoot were statistically significant at the 1 per cent level, indicating

*Hack outsole, ripple outsole, and ripple sole are synonymous.

that all tested footgear had a definite supinating effect. The difference between means obtained with conventional and functional insoles (.9°) was not statistically significant.

TABLE 1. *The means of angle C for both feet of nine subjects standing on two separate planes inclined toward the middle line at 0°, 5°, 10°, 15°, and 20°*

Footgear	0°	5°	10°	15°	20°	Grand mean
Low quarter shoes, conventional insoles (LQc)	4.9	-4.1	-9.3	-12.1	-14.6	-10.0
Low quarter shoes, functional insoles (LQf)	6.2	-5.2	-9.2	-12.4	-14.9	-10.4
Boots, standard outsole, conventional insoles (Sc)	5.4	-3.9	-6.9	-8.8	-10.1	-7.6
Boots, standard outsole, functional insoles (Sf)	6.3	-3.7	-6.0	-9.0	-10.7	-7.4
Boots, Hack outsole, conventional insoles (Hc)	6.0	-3.9	-7.2	-9.2	-11.7	-8.0
Boots, Hack outsole, functional insoles (Hf)	6.4	-4.2	-6.8	-9.5	-11.7	-8.0
Barefoot	1.9	-3.0	-5.8	-7.5	-8.8	-6.3

Negative sign indicates pronation.

Three-way analysis of variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Subjects	8	345.75	43.27	13.1*
Inclination	4	11389.46	2847.36	862.83*
Footgear	6	304.64	50.74	15.38*
Footgear × subjects	48	308.62	6.42	1.94
Subjects × inclination	32	795.95	24.87	7.50*
Inclination × footgear	24	404.24	16.84	5.1*
Error	192	637.26	3.3	
Total	314	14185.92		

*Significant at the 1 per cent level.

Results of the Duncan multiple range test of means given in table 1

Type of footgear	Barefoot	LQc	LQf	Sc	Sf	Hc	Hf
Mean degree of angle C	-6.3	-10.0	-10.4	-7.5	-7.4	-8.0	-8.0

Note: Any two means *not* underscored by the same line are significantly different from each other at the 1 per cent level.

When the Duncan multiple range test was applied to the values of angle C obtained with the inclined planes, it was found that while the difference in angle C between the different types of footgear was significant, there was no difference in the effects of conventional and functional insoles for the same type of footgear.

Effect of distance between the feet upon angle C, barefoot. Subjects stood on a horizontal plane with feet parallel to each other and 6, 10, and 14 inches apart (fig. 2). The purpose of this experiment was to determine the importance of the distance between the feet for diagnostic examination of the patient. Twelve subjects were used. A photographic method of measuring angle C was used.

Table 2 clearly shows that the distance between the feet affected the angle C. With feet 6 inches apart, there was an average pronation of 2.3°. With 10 inches between the feet, the average angle C was .3°, indicating a shift to supination; and

TABLE 2. *Effects of distance between the feet on degrees of angle C in 12 barefoot subjects*

	Distance between the feet		
	6 inches	10 inches	14 inches
Mean for subjects	-2.3°	.3°	1.5°

Negative sign indicates pronation.

Two-way analysis of variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Between subjects	11	295.42	26.86	4.16*
Between conditions	5	186.52	37.30	5.78*
Error	55	354.78	6.45	
Total	71	836.72		

*Significant at the 1 per cent level.

only 5 out of 12 subjects exhibited pronation. With 14 inches, the angle increased to 1.5°. The distance of 10 inches between the feet is therefore the best because in this position the directions of the leg and the heel lines have a tendency to coincide (angle C tends to become zero).

Effect of body weight distribution on angle C, barefoot. Subjects stood on a horizontal plane with feet parallel and 6, 10, and 14 inches apart. They were asked to stand in three different manners: (1) with body weight evenly distributed over feet, (2) with weight shifted to the left foot, and (3) with weight shifted to the right foot. The object of this experiment was to determine how much error might be introduced in the measurement of angle C if the subject's stance was not correct (body weight was not equally distributed on both feet).

TABLE 3. *Effect of body weight distribution on degrees of angle C in barefoot subjects*

	Feet 6 inches apart						Feet 10 inches apart						Feet 14 inches apart					
	BODY WEIGHT DISTRIBUTION																	
	Wt. L*		Wt. E		Wt. R		Wt. L		Wt. E		Wt. R		Wt. L		Wt. E		Wt. R	
	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
Mean	-3.4	.1	-1.8	-2.6	.4	-1.9	-.6	2.0	.9	.2	2.9	-3.1	-.4	3.2	.7	2.2	6.1	-.2
M $\frac{L+R}{2}$	1.7		-2.2		-.8		.7		.6		-.1		1.4		1.5		3.0	

*Wt. L—body weight shifted over left foot; Wt. E—weight distributed evenly over both feet; Wt. R—weight shifted over right foot.

L— left foot; R—right foot; $\frac{L+R}{2}$ = the average of angle C obtained from left and right feet.

Negative sign indicates pronation.

Four-way analysis of variance

Source of variation	Degrees of freedom	Sum of squares	Mean square	F
Main effects				
Distance	2	256.34	128.17	18.41**
Weight	2	11.49	5.74	.82
Subjects	6	544.05	97.34	13.98**
Foot	1	9.45	9.45	1.36
First order interaction				
Distance × weight	4	29.64	7.41	1.06
Distance × subjects	12	89.91	7.49	1.08
Subjects × weight	12	64.35	5.36	.77
Subjects × foot	6	333.07	55.51	7.98**
Distance × foot	2	11.29	5.44	.78
Weight × foot	2	349.19	274.58	39.3**
Combined second and third order interactions	76			
Error		528.80	6.96	

**Significant at the 1 per cent level.

Analysis of variance (table 3) shows that there was a statistically significant effect of weight distribution upon angle C. Shifting of weight over one foot caused an increase in pronation of that foot and increase in supination of the other foot.

When body weight was unequally distributed, the difference between the angles C for the left and right foot was greater than

when the weight was equally distributed. When, however, the average of angle C for both feet was calculated, it was found that the uneven weight distribution had little effect, if any, on the average. The differences were usually less than 2°. This was especially true for 10-inch distance between the feet. When weight was distributed evenly, the average of angle C for both feet was .6°; when weight was shifted to the left foot it became .7°; and when it was shifted to the right it became −.1°, the difference being only a small fraction of a degree.

Comparison of measurements of angle C made with manual goniometer and with photographic method. Subjects stood on either horizontal or inclined planes. Angle C was measured on the same subjects with the manual goniometer and with the photographic method. Altogether, 138 double measurements were made on 17 subjects. The difference between the means obtained with both methods of measurement was .2° and the coefficient of correlation .96. These findings proved that the manual goniometer is a reliable instrument and that it is justifiable now to dispense with the tedious photographic method.

DISCUSSION

The supinating effect of the conventional and functional insoles. As in a previous investigation,[1] the additional supinating effect produced by the functional insole was not statistically significant. Again the question may be raised: Why should *everybody* have a supinating device incorporated into footgear construction? There are a great many people who increase the supinating effect of their footgear just by ordinary walking and by wearing off the outer side of the heel, thus making the medial side of the heel relatively higher.

Attention is called to the fact that the barefoot subjects in this group had a slight supination instead of pronation. This is just a matter of chance. Supination also was observed in some persons in the previous study.

Effect of distance between the feet and weight distribution. The distance of 10 inches between the parallel feet is the preferred distance because in normal legs the leg line and the heel line form an angle equal to zero. Body weight distribution will not affect the average value of angle C calculated for both feet. This can be done by placing a stand with a vertical rod in front of the subject, midway between the feet. If the contours formed by the rod and each leg are identical, weight distribution should be equal.

The introduction of the manual goniometer made the measurement of angle C much easier than with the use of a photographic method. In using this goniometer, the marking system described

in this part of the article should be followed; otherwise, the results obtained will be either questionable or just wrong.

THE FOOT IN WALKING

At the beginning of the study of the foot in walking an attempt was made to measure angle C by the photographic method used in studying the foot in standing. Soon it became evident that this method would require taking a large number of photographs simultaneously from two directions and would demand an enormous amount of time for reducing photographic data to understandable terms. Almost in desperation, an electrogoniometer was invented. This instrument can be attached to the subject's foot, and angle C can be recorded automatically on an oscillograph. The new instrument was used exclusively in this part of the study, the foot in walking.

MATERIALS AND METHODS

An electrogoniometer (fig. 4) is an instrument for automatic recording and measuring of degrees of movement in a joint.

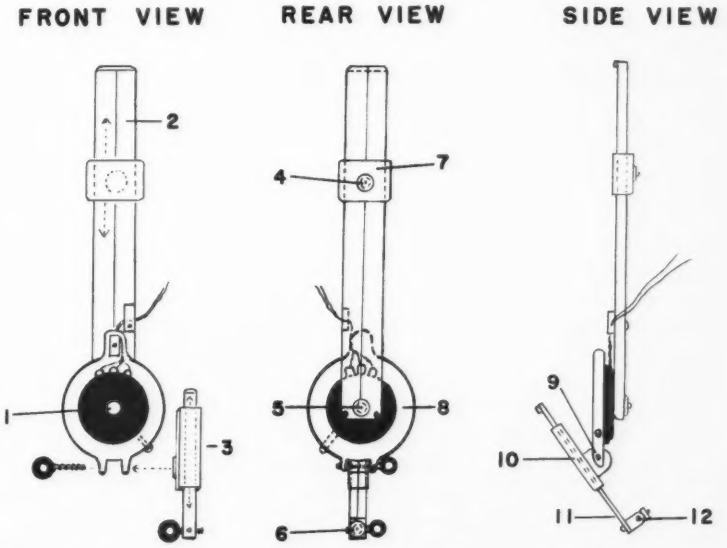

Figure 4. Electrogoniometer for angle C. (1) Rheostat. (2) Long shaft, 5½ inches. (3) Short shaft. (4, 5, and 6) Stud snap fasteners. (7) Short sleeve. (8) Frame. (9) Hinge. (10) Long sleeve. (11) Sliding bar, 1 3/4 inches. (12) Hinge.

Essentially, it is a goniometer in which a rheostat has been substituted for the protractor. Electric current supplied by a small battery is sent through this rheostat to an oscillograph

where changes in voltage are recorded and read off in degrees. The electrogoniometer for the talocalcaneal joint, used in this study, was developed, designed, and built by P. V. Karpovich and G. P. Karpovich. Since completion of this study a universal goniometer, which can be used on other joints has been developed.[2]

To measure angle C with the electrogoniometer, the center of the rheostat (1) is placed on the mid-talocalcaneal point, the long shaft (2) is placed on the leg, and the short shaft (3) on the heel. The electrogoniometer is secured to the leg by means of snap fasteners. The sockets of the fasteners are attached to the middle of small plastic "saddles." These saddles are taped to the leg and foot, and the studs of the snap fasteners are attached to the electrogoniometer and then pressed into the sockets of the saddles.

The long shaft slides in a sleeve (7) to allow for dorsiplantar movements of the foot, and is attached to the housing of the rheostat. The short shaft essentially consists of a sleeve (10), through which passes a sliding bar (11) with a hinged stud of the fastener (12) at the lower end. The sleeve (10) is hinged to the frame (9) which in its turn is secured firmly to the knob of the rheostat. The sleeve of the short shaft and the hinges (9 and 12) allow adaptation of the goniometer to any shape of the heel and eliminate the interference of the dorsiflexion.

The rheostat used for the construction of the goniometer has 0 to 10,000 ohms of resistance, is 1/4 of an inch thick and 5/8 of an inch in diameter.

The plastic saddles used in this investigation ranged from 1½ inches to 2½ inches in length and from ½ inch to ¾ inch in width. Their thickness was 1/16 inch. Each saddle had a slightly different contour, to best fit the contour of the leg and foot at different points. They were secured to the skin by 1-inch-wide adhesive tape. To aid in accurate placing of the saddle, a piece of stiff wire was passed through the fastener of the saddle. The end of the wire was placed on the desired mark on the leg and the saddle was then moved toward the leg, taped to the skin, and then the wire was removed.

For calibration of the goniometer, a special 40° protractor was made, the mid-point of which was designated 0 and the two halves of which were marked off from 1 to 20°. The center of the protractor had a socket snap in which the stud snap of the rheostat could be inserted. The long shaft of the goniometer was immobilized by another socket snap located directly above the center. A plastic extension, with a hairline drawn in the middle, was attached to the short shaft to aid in calibration.

For the sake of lightness and convenience in handling, it was desirable to make this instrument shorter and smaller than the manual goniometer used in the first part of this study. The change in the length of the shaft necessitated determination of a new mark on the leg to which the upper saddle and, therefore, the upper sleeve of the goniometer could be attached. This place should be close to the talocalcaneal joint and should remain on the "leg line" during changes of angle C.

For this purpose, an experiment was conducted on seven subjects. The leg lines were drawn on the skin of both legs, according to the directions given in the study of the foot in standing. The legs were then photographed in three positions: (1) normal, (2) maximum supination, and (3) maximum pronation.

Examination of photographs showed that during supination and pronation the leg line became distorted, forming either a C or S curve (fig. 5). The S curve intersected the true leg line at an average distance of 4.6 inches from the talocalcaneal point.

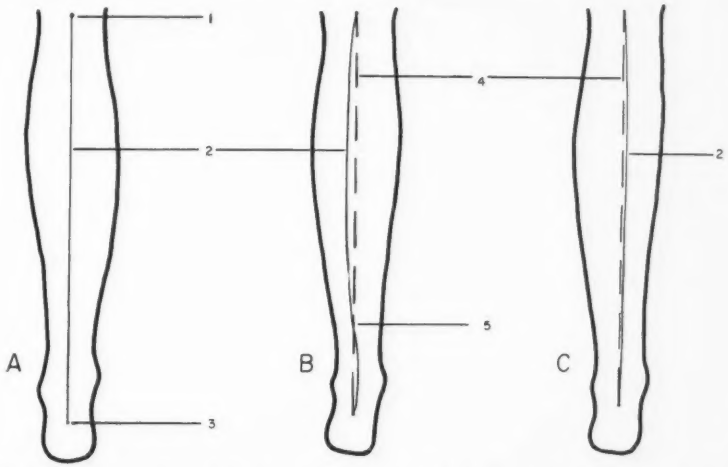

Figure 5. Distortion of the leg line due to skin and muscle movement during supination of right foot. (A) Normal standing. (B) "S" curve distoration. (C) "C" curve distortion. (1) Mark 1. (2) Line drawn on skin. (3) Mark 2. (4) True leg line. (5) Intersection of line drawn on skin and true leg line.

Since the distortion of the leg line, which assumed the shape of the letter C did not intersect the true leg line, it was important to find out what error would be made in measurement of the angle C if the upper sleeve of the goniometer were attached also 4.6 inches above the talocalcaneal center.

Measurements made on 18 subjects showed that the average error would be .63° and the range of error 0-1.5°. For this reason,

it was decided to accept the point 4.6 inches above the talocalcaneal joint as the point of location of the stud anchoring the stud of the sleeve for the long shaft. For expendiency, 4.5 inches, instead of 4.6, was used.

Inasmuch as the central stud of the rheostat is held by the socket part of the snap, it is possible to assume that, if the position of the socket were not always related to the movement in the talocalcaneal joint, this would make the position of the center of the rheostat unrelated to movement and would cause an error in measurements. In order to investigate this situation, a "sandwich," made of two pieces of white paper and a piece of carbon paper in between, was placed over the socket so that the stud of the rheostat could move freely on the paper. Subjects were made to pronate and supinate their feet to the maximum and also to walk. At the end of each test the position of the socket was marked on the paper by a gentle pressure against the snap socket. It was found that the central stud remained remarkably close to the position of the socket. The average of the occasional deviations was 1 mm and mostly downward. Such a displacement reflected little, if at all, on the measurement of angle C. Thus, during subsequent experiments, the electrogoniometer was attached to the points 4, 2, and 3 (fig. 1).

Contact indicators. Flat electric switches were used to indicate the beginning and the end of contact of various parts of the sole with the ground. They were made of two small pieces of cigarette pack foil separated by a piece of perforated adhesive tape. Wires were attached to each piece of foil and the entire switch was covered on the outside by two 1 inch in diameter adhesive tape disks. Even a slight pressure was sufficient to cause a contact between the two pieces of foil. These switches were connected with the oscillograph for simultaneous recording of the changes in angle C. Walking was done on an electrically driven treadmill and also on the floor.

Simultaneous recording of the foot and leg position and angle C. Subjects had electrogoniometers attached to both legs and four flat switches (contact indicators) placed on the sole of each foot: (1) under the heel, half an inch from mid-line to the lateral side and on the most posterior point of the contact with the ground, (2) under the lateral protuberance of the head of the first metatarsal, (3) under the head of the fifth metatarsal; and (4) under the first phalanx of the big toe just next to the joint. Both the electrogoniometers were connected with the oscillograph. Because the oscillograph had four channels, only two of the contact indicators could be added simultaneously.

Simultaneously, with records from the electrogoniometers and contact indicators, photographs of the leg and foot were taken

from the lateral view. Each time a photograph was taken, a mark was automatically made on the oscillograph. This method made it possible to establish the relationship between leg positions and duration of foot contacts with the ground (fig. 6).

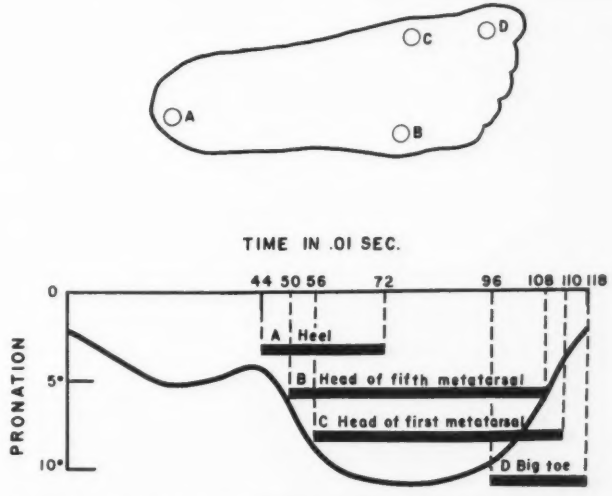

Figure 6. Angle C curve during walking and the sequence of ground contacts of four points on the sole of the foot.

Measuring degrees of angle C on the oscillogram. In order to facilitate analysis of the angle C curve, six points were selected on the curve as landmarks:

1. Big toe leaves the ground.
2. Mid-point of the air phase.
3. Heel touches the ground.
4. Toe of the other foot leaves the ground.
5. Mid-point of the ground phase.
6. Heel of the other foot touches the ground.

This selection was made after studying a number of oscillograms and foot photographs taken simultaneously. At first a *direct* method of measuring angle C was used. In this method every value of angle C at each of the six landmarks was measured and then averaged. This method is extremely time consuming, and therefore another method, called the "ruler method," was used. The ruler method is similar to that used in measuring oxygen consumption from records obtained in basal metabolism tests. In order to find oxygen consumption, a ruler is used to draw a line connecting the tips of expirations records. This line automatically gives the average rate of consumption for the entire test. In measuring angle C, the ruler was used to connect the

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TABLE 4. *Comparison between direct and "ruler" measurements of angle C*

DIRECT MEASUREMENTS

M. P. H.	Type of walking	Landmarks, left foot 1	2	3	4	5	6	Landmarks, right foot 1	2	3	4	5	6
2.39	Natural	-.4	-2.5	.1	-5.5	-6.7	-6.7	1.4	-1.5	0	-3.8	-6.1	-4.7
	Toeing-out	-2.4	-3.9	-.1	-5.6	-6.1	-6.7	-2.3	-3.2	.8	-4.1	-4.6	-3.9
	Parallel	-.3	-2.3	-.3	-4.8	-4.7	-4.7	-.8	-1.5	.6	-4.0	-5.0	-3.9
	Toeing-in	8.2	1.3	2.9	-.6	-2.3	-1.6	11.0	1.8	1.3	-2.5	-3.3	-2.7
2.84	Natural	.7	-2.6	-1.1	-6.1	-6.5	-6.7	5.4	-.7	1.2	-3.4	-3.9	-1.9
	Natural*	.2	-2.9	0	-5.4	-5.4	-6.1	1.7	-2.7	.3	4.9	-5.0	-4.0
	Long steps	1.5	-2.4	1.0	-5.1	-5.1	-5.6	.7	-.9	2.5	-4.1	-3.9	-3.2
	Short steps	.7	-1.8	-1.1	-3.7	-4.8	-3.4	.5	-2.0	.7	-3.6	-5.8	-3.4
3.52	Natural	2.6	-2.2	2.1	-3.7	-4.9	-3.9	4.9	-1.6	1.8	-3.4	-3.4	-1.3

Negative sign indicates pronation.

"RULER" MEASUREMENTS

M.P.H.	Type of walking	Landmarks, left foot 1	2	3	4	5	6	Landmarks, right foot 1	2	3	4	5	6
2.39	Natural	0	-2	0	-5	-7	-5	1	-1	1	-6	-7	-5
	Toeing-out	-2	-4	0	-6	-7	-4	-2	-3	0	-5	-5	-4
	Parallel	-1	-3	0	-5	-6	-2	-1	-2	0	-4	-5	-4
	Toeing-in	10	4	2	0	-3	0	10	2	2	-4	-5	-2
2.84	Natural	1	-2	1	-6	-7	-5	4	-1	1	-4	-4	0
	Natural*	0	-3	0	-4	-5	-4	2	-1	1	-5	-4	0
	Long steps	1	-1	0	4	-7	-3	-1	1	3	-4	-5	-4
	Short steps	1	-2	1	-5	-6	-4	1	-2	0	-4	-6	-4
3.52	Natural	1	-3	1	-4	-5	-4	4	-2	2	-4	-6	-3

*Walking on the ground

Measurement method	Degrees of freedom	Mean	Difference between means: Diff.	S. E. Diff.	T-ratio
Direct	108	-2.154			
"Ruler"	108	-2.018	-.136	.447	.304

The difference is not statistically significant.

identical parts in each step. It is very easy to recognize points 1, 2, 3, and 5. Points 4 and 6 are nothing but points 1 and 3 for the *other* foot and can be found when oscillograms of both feet are obtained simultaneously. Before the ruler method was adapted, it was compared with the direct method (table 4). The mean difference was not statistically significant.

RESULTS

From data obtained on six normal subjects who walked barefoot on the treadmill and on the floor, typical curves were prepared (figs. 7 and 8). They show that the angle C during each step forms a curve which consists of two semicircular dips. One, shallow, corresponding to the "air phase" during which the foot is carried through the air; and the other, a deep one, corresponding to the "ground phase" during which the foot is in contact with the ground. The air phase in this figure occupies

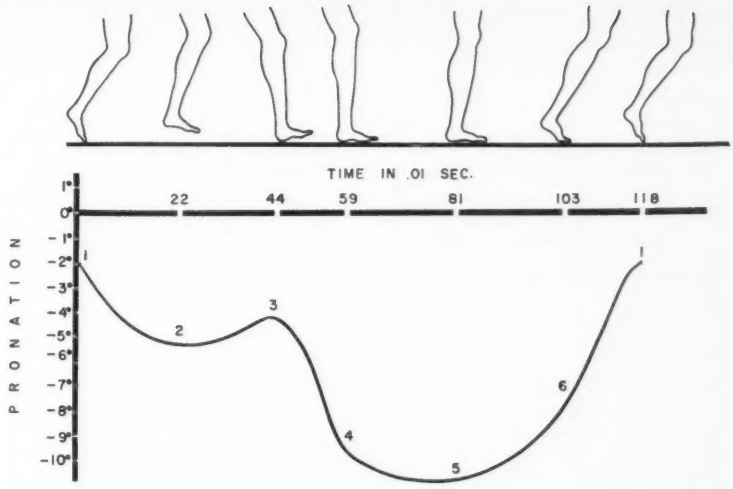

Figure 7. Relation between the position of the leg and foot and the angle C curve. (Medial view of the left leg shown.) (1) Big toe leaves the ground. (2) Mid-point of the air phase. (3) Heel touches the ground. (4) Big toe of the other foot leaves the ground. (5) Mid-point of the ground phase. (6) Heel of the other foot touches the ground.

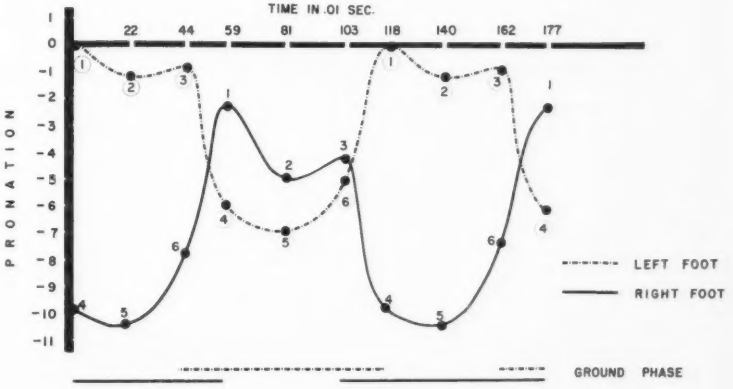

Figure 8. Angle C curves of right and left foot during horizontal barefoot natural walking. (1) Big toe leaves the ground. (2) Mid-point of the air phase. (3) Heel touches the ground. (4) Big toe of other foot leaves the ground. (5) Mid-point of the ground phase. (6) Heel of the other foot touches the ground.

0.44 sec. and the ground phase 0.74 sec. The angle C is in pronation most of the time, especially during the ground phase. This can easily be understood because at that time the foot becomes weight bearing or "emphasized," and this has previously been shown to increase pronation.[1]

The ground phase begins (fig. 6) with the heel touching the ground; 0.05 sec. later the head of the fifth metatarsal, and 0.47 sec. later the big toe contacts the ground. Thus the duration of the ground contacts of these four parts are: (1) heel, 0.28 sec.; (2) head of the fifth metatarsal bone, 0.58 sec.; (3) head of the first metatarsal bone, 0.54 sec.; and (4) big toe, 0.22 sec.

Table 5 and figure 8 show that the variations in the angle C for the right foot were greater than for the left foot. It may also be observed that the amount of pronation was greater in the right foot than in the left throughout the step.

Effect of speed and the length of step on angle C is shown in table 4. Apparently, angle C was the same for speeds of 2.39 m.p.h. and 3.52 m.p.h. The increase in length of step, however, increased the amount of pronation during the ground phase.

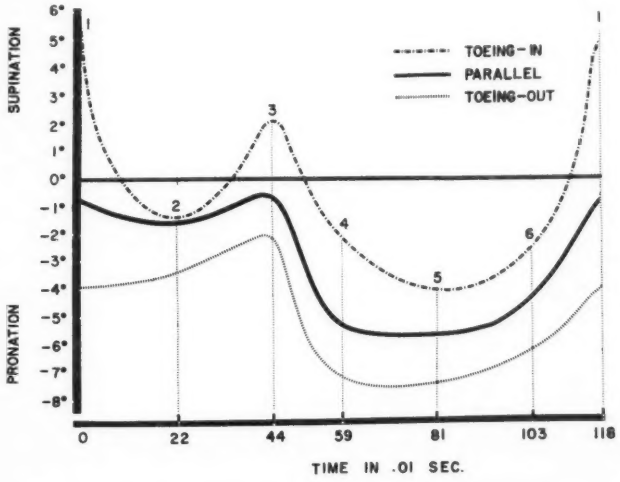

Figure 9. Angle C curves obtained on the left foot in toeing-in, parallel, and toeing-out walking. (1) Big toe leaves the ground. (2) Mid-point of the air phase. (3) Heel touches the ground. (4) Big toe of the other foot leaves the ground. (5) Mid-point of the ground phase. (6) Heel of the other foot touches the ground.

From table 5 and figure 9 it may be seen that, compared to angle C during parallel walking, toeing-out increases pronation

TABLE 5. *Average degrees of angle C at six landmarks on the angle C curve for various types of walking (six subjects)*

M.P.H.	Type of walking	LEFT FOOT Landmark number						RIGHT FOOT Landmark number					
		1	2	3	4	5	6	1	2	3	4	5	6
2.39	Natural	-.5°	-2.2°	-1.2°	-6.7°	-7.8°	-5.7°	-2.5°	-5.0°	-4.0°	-9.7°	-10.7°	-8.8°
	Toeing-out	-4.0	-3.5	-2.0	-7.3	-7.2	-6.2	-7.0	-6.8	-5.3	-10.8	-11.0	-9.5
	Parallel	-7.7	-1.7	-.3	-5.5	-5.7	-3.8	-2.8	-4.8	-3.8	-7.8	-9.3	-6.7
	Toeing-in	5.3	-1.7	2.3	-1.8	-4.2	-1.8	4.8	-2.8	-2.5	-7.3	-1.3	-5.2
2.84	Natural	.5	-1.7	-.5	-6.0	-6.5	-5.2	-1.8	-5.5	-4.3	-10.0	-10.5	-8.0
	Natural*	-.2	-2.5	-1.0	-6.2	-6.7	-5.3	-2.3	-4.5	-4.0	-10.5	-10.8	-7.3
	Long steps	0	-2.0	-.7	-6.3	-8.3	-6.2	-2.3	-4.5	-4.0	-10.3	-11.2	-9.7
	Short steps	-.5	-2.0	-.8	-6.2	-6.5	-4.5	-3.3	-5.7	-4.3	-9.3	-10.5	-6.7
3.52	Natural	.3	-2.3	-.8	-6.8	-7.5	-5.7	-1.7	-4.8	-3.5	-9.7	-10.8	-7.3
Grand average for all natural walking		0	-1.4	-.9	-6.1	-7.1	-5.5	-2.1	-5.3	-4.2	-10.0	-10.7	-7.9

*Walking on the ground. Negative sign indicates pronation.

and toeing-in decreases it. Toeing-in walking caused the greatest change in angle C, the range being from +5.3 to −5.2.

From table 5 one may see that angle C obtained during walking on a treadmill and on the ground were the same.

DISCUSSION

Although the measurement of angle C on oscillograms can be easily made with special scanning machines, these machines are expensive and not always available. The "ruler" method represents a simple, practical, and reliable method.

It was found that during natural walking the amplitude of angle C and the amount of pronation of the right foot were greater than for the left foot. This occurs because, in walking, the right foot toes-out more than the left foot.[3] It was shown in this study that toeing-out increases pronation.

There has been a great deal of debate regarding the correct position of the feet in walking. Some writers have advocated toeing-in and others, the parallel position.[4] One of the factors frequently contributing to foot discomfort is excessive pronation.[4–7] If this be true, then reduction in the amount of pronation would be beneficial. Toeing-out, therefore, should be avoided.

Exaggerated toeing-in as used in this study is, however, uncomfortable and subjects tend to lose their balance. This type of walking, therefore, cannot be recommended.

SUMMARY AND CONCLUSIONS

A study of pronation and supination of the human foot (1) in standing and (2) in walking was carried out.

1. *The foot in standing.* The supinating effect of footgear with conventional and functional insoles was compared in subjects standing on a horizontal plane. With conventional insoles there was 5.4° of supination, whereas the functional insoles produced 6.3°. The difference, however, was not statistically significant. In subjects standing on inclined planes adjusted at 5°, 10°, 15°, and 20° of pronation, the functional insoles caused no statistically significant supinating effect. The need of an increase in supination for everybody was questioned.

For a diagnostic examination, a distance of 10 inches between parallel feet is preferred because the angle C at that position tends to be zero; therefore, deviations may be more easily observed. During an examination, the body weight should be evenly distributed because shifting weight to one foot increases pronation in that foot. The manual goniometer for measuring angle C was described. This instrument should supplant the time-con-

suming photographic method. The accuracy of this instrument is high. The difference between the means obtained with photographic and goniometric methods was 0.2° and the coefficient of correlation 0.96.

2. *The foot in walking.* An electrogoniometer was developed as an aid in studying the foot in walking. This instrument can be used for automatic recording or quick direct measuring of angle C.

A typical angle C curve consists of two arcuate dips. One is shallow, corresponding to the air phase during which the foot travels through the air, and the other a deep one, corresponding to the ground phase. In most people angle C is in pronation. The right foot is more pronated than the left foot. Toeing-out increases and toeing-in decreases pronation. Angle C was the same for speeds of 2.39 m.p.h. and 3.52 m.p.h. Increase in length of step increased pronation. Angle C was the same when subjects walked on treadmill and on the floor.

Electrogoniometers for other joints are being developed. The development of the electrogoniometer has opened a new avenue for study of normal and abnormal joints in motion.

ACKNOWLEDGMENT: The authors wish to acknowledge assistance given by Messrs. Robert J. Alteveer, Daniel H. Coates, Norris W. Eastman, and Leslie J. Judd, and Miss Clare E. Condron.

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If a man can have only one kind of sense, let him have common sense. If he has that and uncommon sense too, he is not far from genius.—H. W. Beecher.

NEW TRACTION DEVICE FOR TRANSPORTATION OF PATIENTS WITH FRACTURE-DISLOCATION OF CERVICAL SPINE

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THE patient with a fresh fracture-dislocation of the cervical spine is in a dire position. Only good management can avert the catastrophe of temporary or permanent quadriplegia in a patient not previously paralyzed. Good management of the patient with a definite or suspected fracture-dislocation of the cervical spine must begin with the emergency situation. Aggravation of an already dangerous situation must be prevented and nothing done to increase the bony deformity. This is accomplished by maintaining traction in the spinal axis while transferring the patient to a litter and while transporting the patient on the litter to the hospital.[1]

For many patients further transportation to a neurosurgical center will be necessary. Here, too, the same care and diligence is required. A recent survey of 2,500 cases delivered by ambulance to the hospitals of a large city revealed that a number of cases "could have been killed or reduced to permanent invalidism by a rough ambulance ride."[2] Because of the extreme incapacitation associated with traumatic injuries to the cervical spine, aggravation of this sort must be avoided at all costs.

The devices available for immobilization of neck fractures were strong, willing hands, blankets, sandbags or the tying of a halter to a cross-bar on a litter, with the free-swinging weights associated with the traction setup attached to the litter or over a chair placed on its side,[3] or to a Stryker frame. With any of these, it was impossible to maintain steady, continuous traction of a predetermined amount. This leaves it pretty much up to chance whether or not the patient's difficulty will be intensified in transfer to nearby medical facilities.

The military physician has an additional problem in regard to transportation of these patients in traction. His neurosurgical

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treatment referral center may be at a great distance that requires air evacuation flights up to 30 hours for further hospitalization, treatment and rehabilitation. One of us (J. M. C.), as a member of such an air evacuation team, observed that patients in weight traction experience considerable pain and discomfort when flying through turbulent air or riding in ambulances. Tests, conducted using a 10-pound weight suspended from a simulated patient with pulleys, a steel-wire cable, and a tensiometer, revealed that patients in weight traction in aircraft or ambulances receive rapid and frequent jolts of two and one-half times the amount of traction prescribed. Specifically, in these tests the tensiometer revealed moments of weightlessness followed by weight loads up to 25 pounds. A traction unit was designed* that would facilitate the air and surface transfer of such patients and provide level, steady, dependable traction during the transfer period.

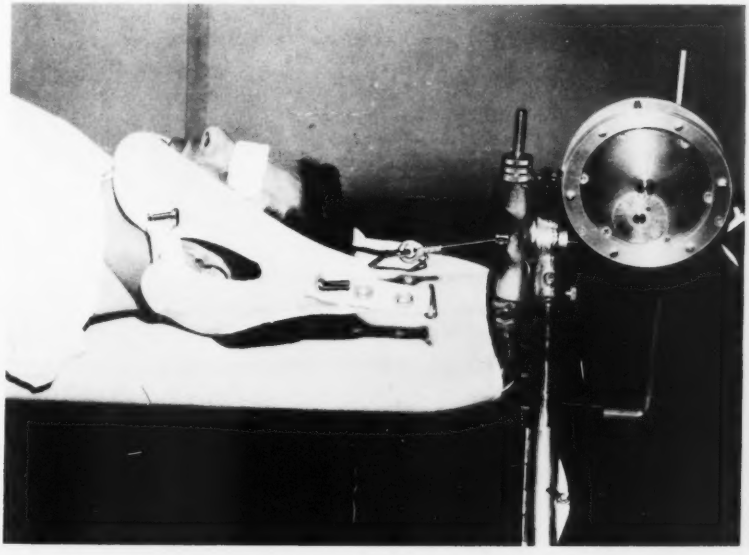

Figure 1. The traction device in use on a Stryker frame showing dial for direct reading in pounds of traction.

This traction unit consists primarily of a drum onto which a wire cable is wound, with the distal end of the wire cable attached either to a cervical halter or to Crutchfield tongs. A crank rotates the drum to permit increasing or decreasing tension and a dial gives direct readings in pounds of traction (fig. 1). Inside the drum there is a spring-type arrangement to permit extension of the cable for movement of the patient up to two and

*Patent applied for.

one-half inches while the amount of traction changes only one pound. Therefore, for changes of traction of plus or minus one pound, a distance of five inches of patient movement is possible. Testing situations show that this is unlikely to occur under even the most turbulent conditions. Other equipment for the traction unit consists of a variety of clamps to permit its attachment to the handles of a litter, to a Stryker frame or to a hospital bed (fig. 2).

Figure 2. The traction device attached to a hospital bed.

The traction device was tested many times on healthy persons in a variety of situations, such as in aircraft in turbulent weather, and produced steady, unvarying traction. Although it was originally designed for air evacuation purposes, it was also tested in ground transportation situations where it functioned very well. Subsequent to these tests, the apparatus has been used on four patients, each of whom had cervical spine injuries and two of whom were quadriplegic, and all but one had Crutchfield tongs in place.

TESTS WITH FRACTURE CASES

The first patient had a compression fracture of the sixth cervical vertebra and an extreme degree of cervical paraspinal muscle spasm with torticollis. The traction apparatus was applied to the head of his hospital bed and used by this patient very comfortably for about two days in lieu of pulley and weights. Repeated checking failed to reveal over one pound of deviation in his cervical traction throughout all the turning and manipulations necessary in his care. Two other patients had fracture-dislocations of the cervical spine with quadriplegia and the apparatus was attached to their Stryker frames. The traction

device was also used to bring a patient from Korea to this hospital on a frame. The evacuation was carried out in turbulent weather and delivered uniform traction to the patient without relaying the turbulence and changes of pressure to his neck. The third patient was air evacuated from this hospital to Hickam Air Force Base on a Stryker frame in the new apparatus. The patient was then removed from this type traction and placed in the old type of pulley set-up. The patient observed that he was very comfortable and obtained uniform traction in the new device and found it most uncomfortable to return to the old type. The fourth patient was removed from a homemade pulley traction set-up at this hospital and put in the Collins traction device for helicopter transfer to the U. S. Naval Hospital, Yokosuka, Japan, for definitive treatment by a naval neurosurgeon. A steady ten pounds of traction was comfortably and easily maintained throughout this second-stage transfer.

While this traction device has had a very limited number of trials, it is thought that the idea of this method of traction is sound and that the mechanism does provide the stable, uniform traction predicted for it. The unit was easy to set up and to handle and was quickly adapted to a bed, a Stryker frame, or a stretcher. The ground transportation of these patients was facilitated by the use of this apparatus. It is predicted that the apparatus will work equally well in emergency situations where only a neck halter is available, such as at an outlying hospital dispensary or where an ambulance has been called to the site of an accident. Perhaps the greatest value of this device will be in the emergency transfer of patients from the scene of an accident to a dispensary or hospital and in the second-stage transfer to a neurosurgical center for definitive care. This unit is also adaptable to other fractures in which traction is desired. Its usefulness will be limited only by the ingenuity of those who possess the device.

SUMMARY

The hazardous situation of the patient with a fracture-dislocation of the cervical spine, especially while being transported, is noted. A new universally adaptable apparatus is described that will provide uniform dependable traction during patient transfer and that will reduce the risk of aggravating the deformity.

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PATHOLOGIC IMPLICATION OF THE CATECHOL AMINES, EPINEPHRINE AND NOREPINEPHRINE

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CONTROVERSY exists in regard to the therapeutic use of sympathoadrenal pressor amines in hypotensive states and clinical shock. Their effectiveness in hemorrhagic and cardiogenic shock in regard to survival is the subject of numerous articles, employing statistical, experimental, and clinical methods.[1-4]

Very little attention has been paid to the tissue changes produced by therapeutic amounts of epinephrine and norepinephrine, although the potent necrotizing property of these amines is well known to the clinician in the form of skin sloughs. A previous report from this school attributed clinically unrecognized myocarditis to prolonged infusion of norepinephrine (NE).[5] At this institution similar changes were experimentally produced in dogs.[5] Morphologic changes in the kidney[6] and liver[7] with NE therapy have been reported from human autopsy material.

Epinephrine inhalation therapy reportedly produced necrotizing changes in the respiratory mucosa.[8] Instances of fatal poisoning by parenteral injection of epinephrine were reported by Gormsen[9] and others.[10] The autopsy material in epinephrine poisoning cases showed pulmonary edema, venous and capillary congestion of viscera, and acute renal hemorrhages. Similar findings have been frequently reported in victims of pheochromocytoma of all ages. In pheochromocytoma foci of myocardial necrosis in different stages of healing, hypertrophy, and widespread arteriosclerosis are commonly present. These cases of pheochromocytoma can be utilized to show practically all the known lesions produced by catechol amines. Chronic intermittent parenteral injections of catechol amines in experimental animals led to intimal proliferation and arteriopathy with medial necrosis.[11-13]

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Presented on 7 May 1959 at a seminar of the Surgical Physiology Section, Walter Reed Army Institute of Research, Washington, D. C.

The recognition and evaluation of the structural changes and their impairment of function may serve to further the understanding of the pharmacodynamics of catechol amine therapy.

MATERIALS AND METHODS

A complete review of the earlier literature would be too lengthy for presentation, but selected articles with aspects regarding morphology and pathogenesis of the lesions produced by catechol amines have been incorporated.

We selected illustrative cases from human autopsy and surgical material of patients treated with catechol amines or affected with pheochromocytoma. We also used illustrations of experimental lesions produced in dogs by NE infusions. Details of those experiments from this institution are reported elsewhere.[5,14] With these illustrations we hope to emphasize the pathologic changes that might be observed by the general pathologist in clinical practice.

The multiplicity of morphologic changes produced by catechol amines is directly related to the dosage rate and the route of administration.

SKIN AND MUCOUS MEMBRANE LESIONS

Subcutaneous infusion of serum enriched with 5 to 10 per cent dextrose in the treatment of shock was considered effective in the 1920's. Efforts to increase blood pressure led to adding epinephrine to such hypodermoclysis. The result was disastrous. The favorite sites of administration being beneath the breast, or the abdominal wall, necrotic sloughs of the anterior chest and abdominal walls resulted.[15]

Ischemic necrosis complicating norepinephrine therapy has been a frequent occurrence in clinical practice since 1951.[16,17] Sloughs might result not only in the areas of accidental extravasation of the intravenous fluids containing the amine, but apparently also along the infused veins,[18] especially when the lower extremity is the site of injection.

The pathogenesis of these lesions received much attention.[19] Necrosis was produced regularly with prolonged, voluminous infusions of NE in low concentrations, while single subcutaneous injections of even highly concentrated solutions failed to produce necrosis in normal domestic rabbits.[20] Necrotizing lesions are seen in a much higher incidence when hemorrhagic shock is treated with NE infusions.[21] In hemorrhagic states the plasma concentrations of endogenous catechol amines are greatly increased.[22] The peripheral vessels are contracted and the skin is ischemic. Additional vasoconstriction in response to small amounts of exogenous catechol amines leads to necrosis.

In the absence of gross paravenous infiltration, venous spasm proximal to the venous cannula and reduced blood flow due to ligation of the vein distally allows stagnation and building up of high concentration of the pressor amines. If the saphenous vein is used, the hydrostatic pressure of the infusion fluid propels the drug into the collateral veins, capillaries, and arterioles, leading to contraction of the vessels, hypoxia, and leakage from the lumen into the surrounding tissues. If the contraction phase is not relieved spontaneously or by injection of adrenolytic agents necrosis occurs with thrombosis of the blood vessels.

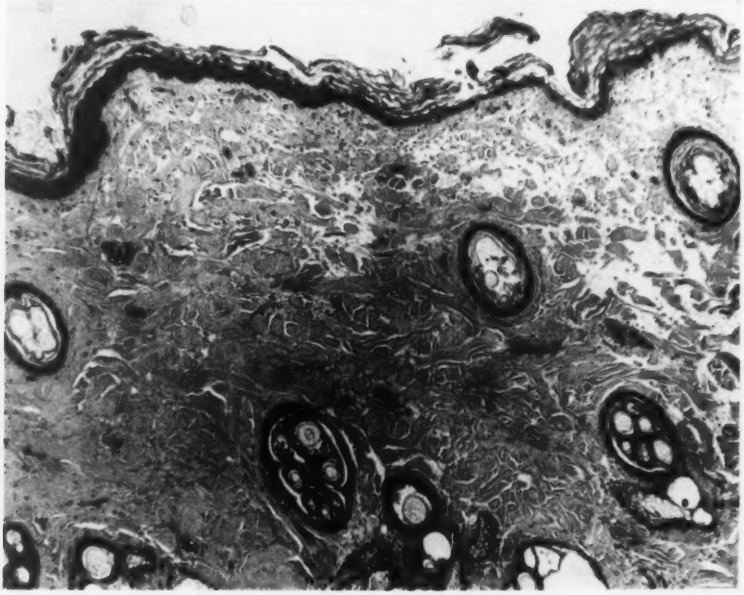

Figure 1. Photomicrograph of skin from a dog which received a prolonged subcutaneous infusion of norepinephrine (12 mg/1,000 ml of 5 per cent dextrose in water). The section compares the necrotic zone (right) with adjacent normal skin (left). Note edema and fragmentation of collagen bundles in the dermis, and the loss of nuclear staining properties in the basal layer of the affected epidermis. (Hematoxylin-eosin stain, ×40)

The gross appearance of the lesion gradually progresses from a blanched skin to edema with purplish discoloration, vesicle formation, and gangrene. Microscopically, marked edema, swelling of collagen fibers, moderate leukocytic infiltrate and some red blood cells are seen in the dermis (figs. 1 and 2). The epidermis shows suprabasilar cleavage with acellular vesicles. The nuclei gradually lose their basophilic staining capacity.

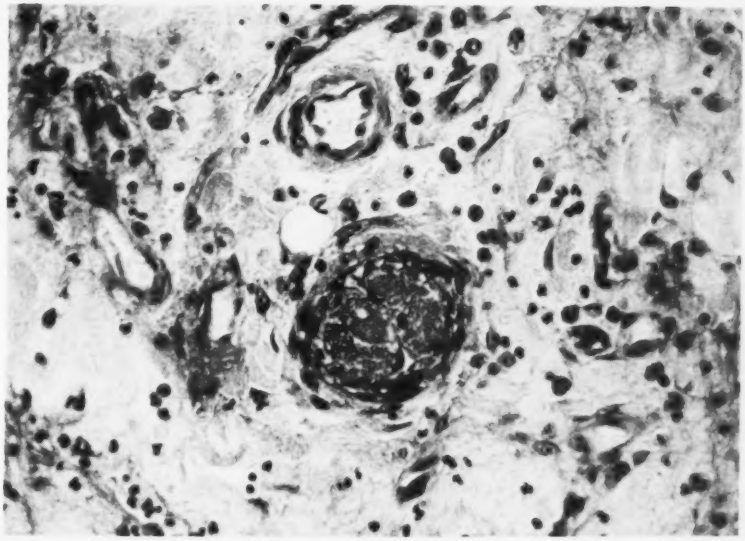

Figure 2. Photomicrograph of subcutaneous tissue from the same specimen as figure 1, demonstrating vascular thrombosis and inflammatory infiltration. (Hematoxylin-eosin stain ×240)

Figure 3. Ischemic necrosis in a 23-year-old woman following norepinephrine infusion. View after debridement and before grafting, showing exposure of tibia. (Courtesy of Capt. J. R. Connelly, MC, USN[23])

Epidermal necrosis and slough are usually associated with involvement of the deeper layers, the extent of the lesion being determined by the degree of vascular involvement.

Occasionally the ischemic necrosis will take the clinical form of dry gangrene as in a case treated by Connelly,[23] who reported necrosis even of the underlying bone (fig. 3). In that case thrombophlebitis was marked. In our experimental material on normovolemic dogs using polyethylene catheters, phlebitis consisted of only moderate leukocytic infiltration of the vessel wall without occlusion, even when the infusion was continued for 16 days.

Figure 4. Photograph of the mitral valve in a dog infused with norepinephrine at a rate of 15 mcg/min/kg for 1 hour. Note the massive hemorrhage at the base of the posterior leaflet.

Effective prevention of skin necrosis hinges on the use of long, venous catheters and fast dilution of the pressor amines in the circulating blood. This usually can be, but not always,

accomplished by passing a polyethylene catheter through the antecubital veins cephalad to larger vessels.[24, 25]

Mucosal lesions following inhalation of 1 per cent epinephrine solutions were described by Galgiani and associates[8] 20 years ago. This solution has been commonly used by asthmatics for relief of bronchial spasm. The lesions consist of complete slough of the tracheal epithelium with a lymphocytic infiltration of the submucosa. The same physicians observed multiple small

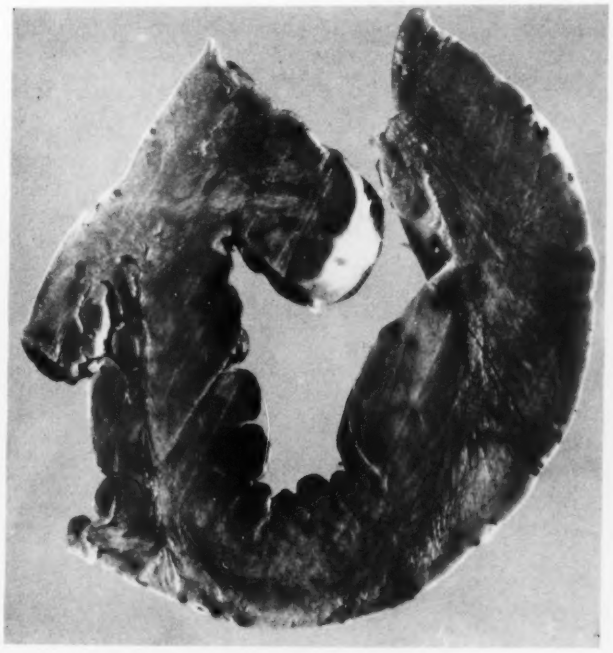

Figure 5. A cross section from a dog's heart infused with norepinephrine at a rate of 1.4 mcg/min/kg for 17 hours. Note the myocardial hemorrhage. The lesions are more marked in the subendocardial areas, but by no means restricted to it.

ulcerated and hemorrhagic areas in the gastrointestinal mucosa of cats which had received solutions of epinephrine orally. These lesions were accompanied by inflammatory changes in the intestinal wall and peritoneum. Norepinephrine has little value as a bronchial dilator; therefore it is not indicated for inhalation therapy, and its possible local necrotizing effect on mucosal surfaces has little or no clinical importance.

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THE CARDIOVASCULAR SYSTEM

The cardiovascular system is the first to show gross pathologic changes on intravenous administration of the catechol amines. The gross appearances of the lesions and the manner in which they are produced vary with the infusion rate of norepinephrine. This has been borne out by recent quantitative work from this institution which will be the subject of a separate report.[14] High rates of infusion in dogs (10-15 mcg/min/kg of NE) produce sudden increase of mean blood pressure up to and exceeding 300 mm of mercury, imposing severe mechanical injury on the mitral valve. The valve at its attachment becomes massively hemorrhagic, although rupture has not been observed (fig. 4).

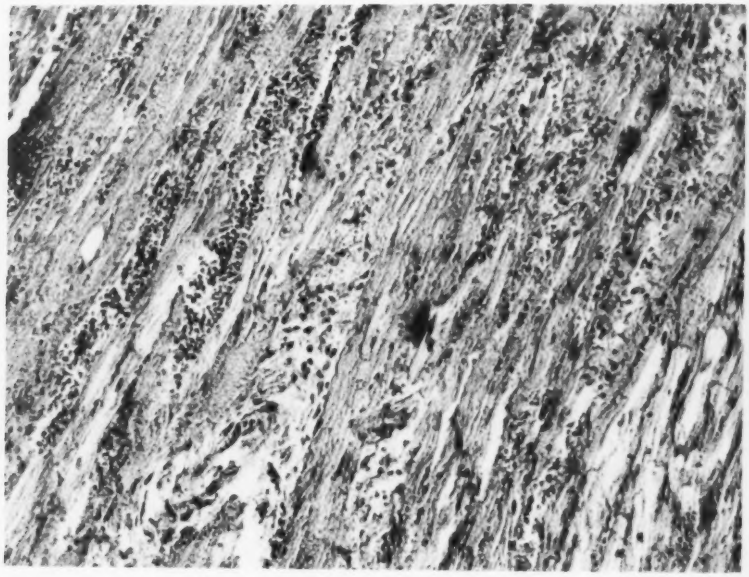

Figure 6. Photomicrograph of myocardium from the heart illustrated in figure 5. Note the myofibrillar degeneration, hemorrhage, and early inflammatory exudate. (Hematoxylin-eosin stain, ×120)

Dosages corresponding to the therapeutic range in man (from 1-1.5 mcg/min/kg of NE) produce mean blood pressure increases averaging 30 mm of mercury in unanesthetized dogs. The pressure response in these animals is not sufficient to produce acute mechanical injury in the valves, and the development of myocardial lesions is a function of time. Two-thirds of the animals that received therapeutic dosages developed gross changes after 10 hours of continuous infusion. The early changes consisted of myocardial hemorrhage, more marked on the endocardial surfaces, with minimal or no involvement of the cardiac valves

(figs. 5 and 6). Later changes consisted of focal areas of myocardial necrosis (fig. 7). By the end of 1 week, a cellular reaction was present. Morphologically the criteria of myocarditis were met and this term has been applied to these experimental lesions by earlier investigators[26, 27] and ourselves. These lesions gradually progressed to focal fibrosis and endocardial thickening in about 6 weeks.

Figure 7. Photomicrograph of myocardium from a dog treated with norepinephrine at rate of 1.5 mcg/min/kg for 24 hours. Note the marked myofibrillar degeneration, the presence of some inflammatory cells, but complete absence of hemorrhage. (Hematoxylin-eosin stain, ×240)

Smaller dosages, 0.8 mcg/min/kg of NE, produced no gross lesions; but when continued for several days, resulted in focal areas of myocarditis.

These data correspond with clinical observations, both in patients treated with NE, and those suffering with pheochromocytoma (figs. 8 and 9). Pheochromocytoma by its chronicity, produces myocardial hypertrophy, necrosis, and myocarditis which is sometimes indistinguishable from infarction. Scattered areas of fibrosis appear in later stages.

The pathogenesis was explained by Raab[28] on the basis of myocardial hypoxia produced by the catechol amines. A large group of substances with high redox potential, quinones and particularly catechol amines, increase the oxygen uptake of

cells, but this oxygen consumption is uncoupled from phosphorylation and wasted. The arterioles, capillaries, and surrounding tissues absorb the catechol amine and increase the oxygen uptake. This produces a progressive oxygen debt, loss of potassium, and accumulation of lactic acid in the tissues along the distal portions of these vessels. Ultimately hypoxic necrosis results.

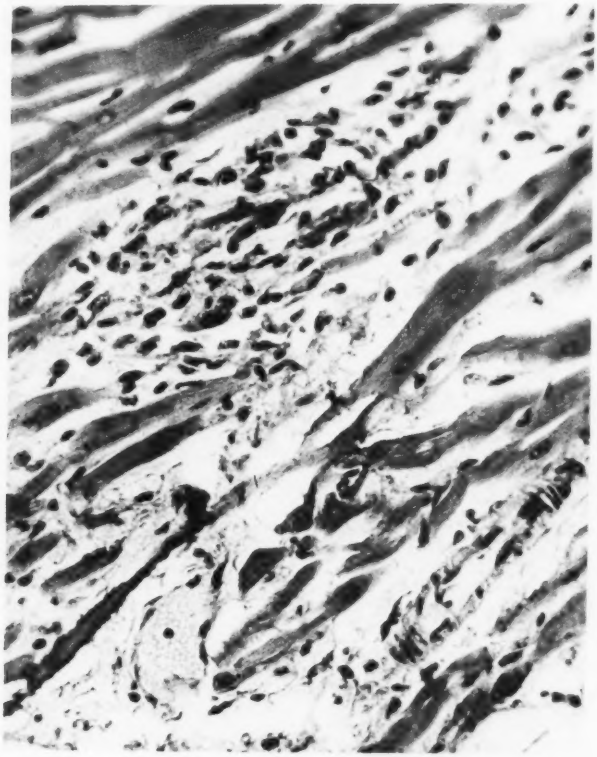

Figure 8. Photomicrograph of myocardium from a patient with pheochromocytoma. Note the active focal myocarditis. (Hematoxylin-eosin stain, × 160) Accession No. 647330, Armed Forces Institute of Pathology.

The arteriolar walls of the coronary system appear to be most susceptible to these effects. These vessels are the earliest to show fibrinoid degeneration and necrosis. However, we have observed such lesions in the vessels of the gastrointestinal walls after prolonged infusions. A remarkable reaction of the arterial intima is endothelial proliferation that occurs with chronic administration of catechol amines (figs. 10 and 11). This process, widely studied for its importance in atherogenesis,

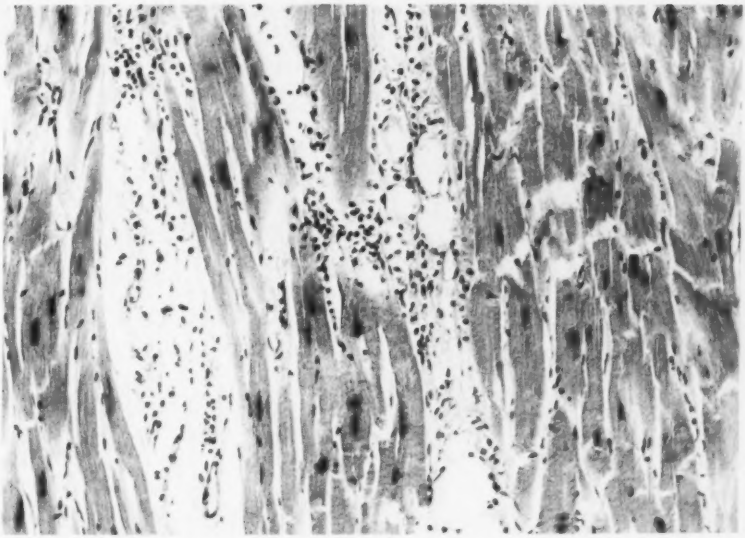

Figure 9. Myocarditis in a female patient treated with norepinephrine for several days. (Hematoxylin-eosin stain, ×120)

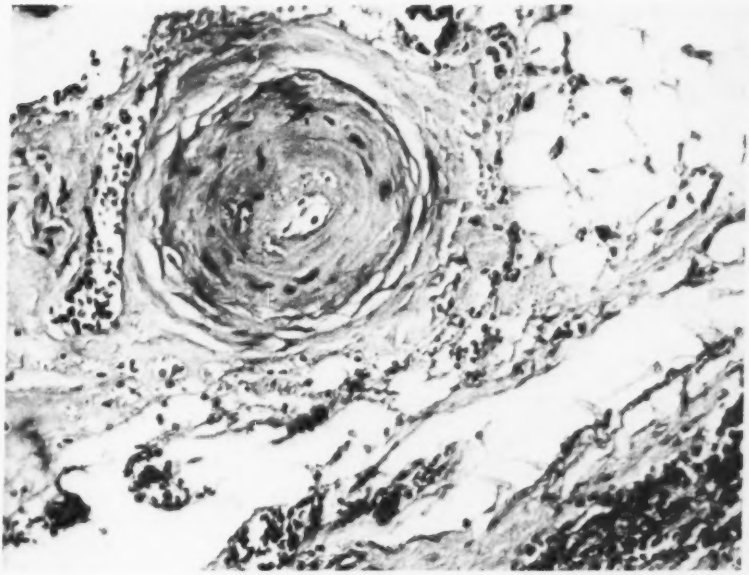

Figure 10. Severe intimal proliferation in an intestinal arteriole from a 9-year-old child with pheochromocytoma. (Hematoxylin-eosin stain, ×240)

has led occasionally to complete obstruction of small arteries of the gastrointestinal tract, leading to infarction and perforation of the bowel. Similar lesions have been produced in animal experiments.[29]

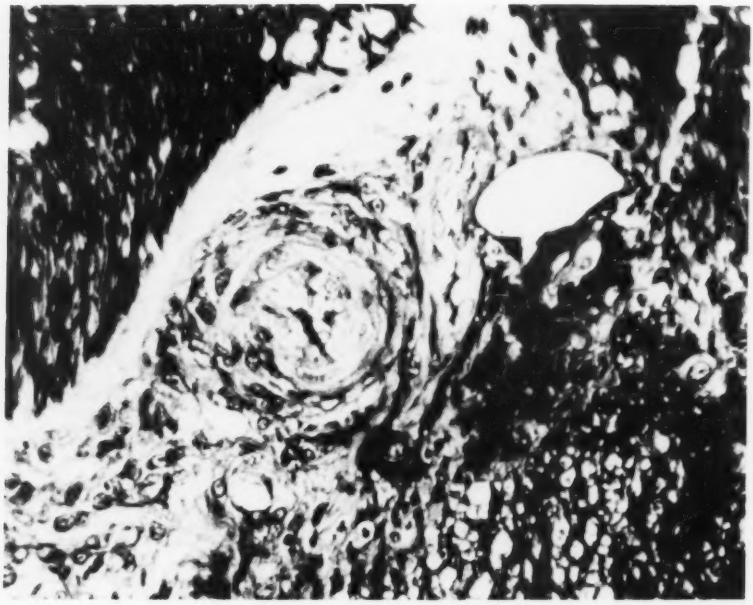

Figure 11. Arteriole in dog ileum to show intimal proliferation and swelling of the endothelial cells following treatment with norepinephrine.

Congestive changes appear systemically, particularly in the liver and kidneys, partly as a result of the functional impairment produced by lesions in the heart. On the basis of a statistical study, Brunson, Eckman, and Campbell[7] presented a possible role of the sympathomimetic amines in the production of hepatic necrosis. Such lesions have not been demonstrated in the experimental animals using constant rate infusions of NE up to 1.5 mcg/min/kg for as long as 17 hours. Massive dosages resulted in moderate venous dilatation and congestion associated with varying degrees of parenchymal degeneration.

Fatty infiltration and vacuolization of the hepatic cells occurs following epinephrine infusions.[30]

KIDNEYS

Pathologic changes have been found in renal biopsy specimens from patients with pheochromocytomal[31] in cases of acute epinephrine poisoning,[9] and in patients treated with NE.[6] The circulatory changes and secretory activity were studied by

many investigators regarding salt and water excretion.[32] We consistently found proteinuria in dogs infused with NE. At a constant rate of infusion the amount of urinary protein increased with the time. Proteinuria is certainly associated with the circulatory impairment. The morphologic changes varied, however, with the amount of catechol amines administered. With therapeutic doses of NE, the slight changes were difficult to recognize.

In acute epinephrine poisoning in man the first hypertensive phase is followed by a shocklike picture with low blood pressure and the patient dies in circulatory failure with pulmonary edema. At necropsy the kidneys and the glomerular capillaries are congested. Focal areas of cortical hemorrhages are present. The medulla shows gross hemorrhage. The venules, as well as the capillaries, are markedly dilated. Some of Bowman's capsules contain red cells and proteinaceous material. The tubular epithelium shows ischemic necrosis. Similar lesions have been reproduced in the rabbit and were described by Valleri-Radot, Albeaux-Fernet, and Delamare[33] as "hyperacute hemorrhagic nephritis."

In patients, the changes following NE therapy are difficult to evaluate. Necrosis of the epithelium in the convoluted tubules has been described by Boughton and Sommers.[6] The very fact that these patients needed NE therapy indicates that the general circulation was impaired before the therapy began. In intact dogs infused with NE with comparable doses (1 to 1.5 mcg/min/kg) we observed capillary and venous engorgement with varying quantities of proteinaceous exudate within the lumina of the convoluted tubules. However, no necrosis of the tubular epithelium was seen. Higher doses (3 to 15 mcg/min/kg) led to hemorrhage in the corticomedullary junction and necrosis of the tubular epithelium (figs. 12 and 13). In the kidneys of infused normal animals none of the larger arterioles exhibited endothelial swelling or degenerative changes, although in the spleen of these animals marked hydropic degeneration of the arterial intima was seen constantly (fig. 14). Some dogs with advanced pyelonephritis and sclerosis of the arcuate arteries showed acute subendothelial hemorrhages following NE infusion.

Oliguria and anuria were produced in experimental animals by Hatcher and associates[34] by introducing epinephrine or NE directly into the renal artery. It is interesting that these animals did not show any systemic blood pressure rise following injections of up to 10 mcg/min/dog. The pathologic findings in these kidneys were ischemic necrosis of the renal cortex and hemorrhagic infarction of the medulla.

Figure 12. Kidney from a dog treated with norepinephrine at a rate of 3 mcg/min/kg for 48 hours. Note the linear hemorrhage in the corticomedullary junction.

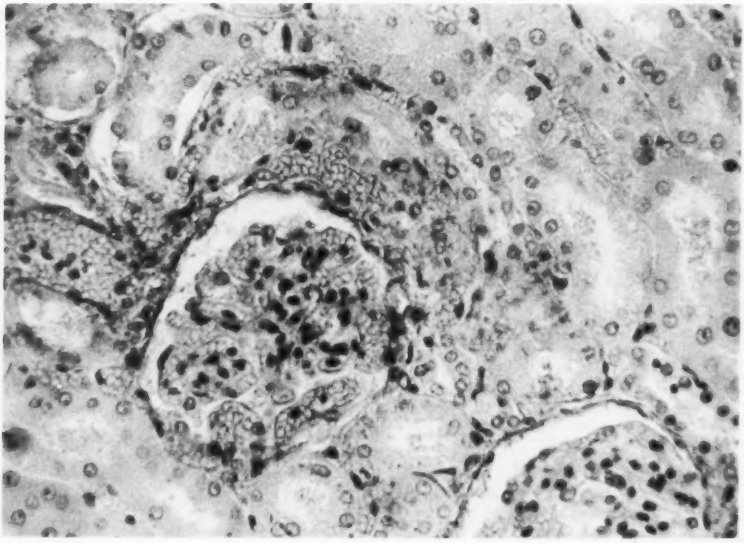

Figure 13. High-power view of cortex from the kidney illustrated in figure 12. Note the engorgement of the capillaries and venules, the proteinaceous precipitate in Bowman's capsule and degeneration of the tubular epithelium. (Hematoxylin-eosin stain, ×240)

Figure 14. Photomicrograph of spleen from a dog treated with norepinephrine at a rate of 10 mcg/min/kg for 3 hours. Note the marked hydropic degeneration of the arterial intima in the center. (Hematoxylin-eosin stain, ×260)

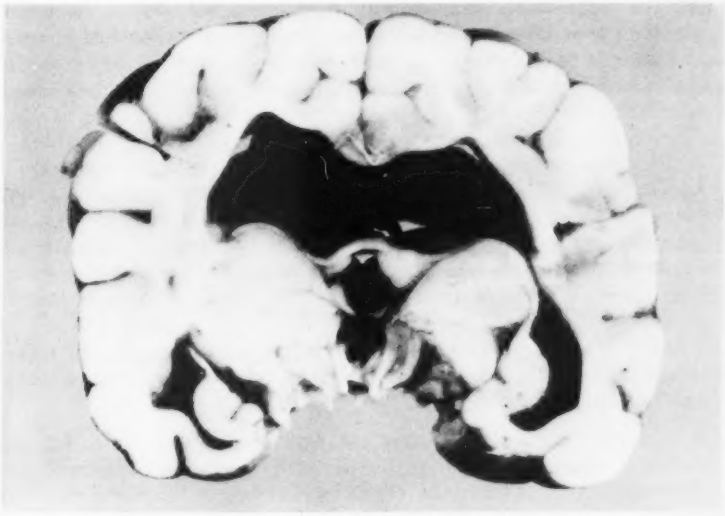

Figure 15. Dog brain, illustrating the massive hemorrhage into the cerebral ventricles, following norepinephrine infusion at a rate of 10 mcg/min/kg for 3 hours.

CENTRAL NERVOUS SYSTEM

Clinically diagnosed cases of cerebrovascular accident following the subcutaneous administration of 0.5 ml of a 1:1000 solution of epinephrine have been reported.[35,36] Hemiplegia persisted for 5 weeks in Applebaum's[35] first case, a 28-year-old man. Flexner and Schneider[37] reported a case of subarachnoidal hemorrhage following epinephrine injection. Subarachnoidal hemorrhage and focal cortical perivascular hemorrhage with marked dilation of capillaries and arterioles were described by Stief and Tokay[38] in experimental animals. These authors found focal "miliary" paling and devastation of cortical cells as a result of chronic intermittent administration of epinephrine. The lesions were surrounded by marked glial proliferation and progressed to scarring ("vasogen cicatrices"). Gross cerebral hemorrhages were observed in rabbits following epinephrine injection in 1905.[39]

Norepinephrine in massive dose could conceivably produce cerebral hemorrhagic lesions, especially if pre-existing vascular anomalies were present. In our experiments with varying doses of NE, only 1 out of 30 dogs developed cerebral hemorrhage. This animal had received 10 mcg/min/kg of NE. No focal infarcts or cicatrices were seen in the remaining dog brains on microscopic examination (fig. 15).

LUNGS

Pulmonary lesions have not been reported following therapeutic doses of catechol amines. Pulmonary edema occurs in acute poisoning with massive doses. It is apparently centrally mediated since it is prevented in cats by transection of the cervical spinal cord,[40] and it was absent in the dog which developed cerebral hemorrhage.

CONCLUSIONS

Earlier investigators have recognized both the local and systemic lesions produced by epinephrine. Norepinephrine similarly has tissue-necrotizing properties, and its local complications are of common knowledge. The systemic lesions produced by NE became recognized only recently, although for years Raab[28] emphasized the pathogenic significance of catechol amines in the heart. Our present knowledge of the pathogenesis of these lesions is far from complete; however, we shall mention some of the factors involved.

At least two different mechanisms are responsible for the pathologic changes produced by NE. One is mechanical and due to hemodynamic factors; the other is a chemical factor producing derangement in cellular oxidation by uncoupling oxidation from phosphorylation. The best examples of the first mechanism are the massive cerebral hemorrhage and hemorrhage into the mitral

valve. These lesions depend more on the rate of the infusion than on the total dose administered, and can be produced by a single injection. The second mechanism is best illustrated by the myocardial necrosis following low dosage and constant rate infusions of NE. It is not associated with marked changes in blood pressure, or valvular hemorrhage. Hemodynamic changes then are combined with the hypoxiating effects of NE in the production of lesions of the liver, kidneys, and large vessels. Other added factors are operating in the production of skin necroses. These factors include the hydrostatic pressure of the infiltrating fluid and local anatomic peculiarities of the vessels, as in the case of the lower extremity.

Norepinephrine, while it is truly a lifesaving drug when used as a specific therapeutic agent in the postoperative management of pheochromocytoma, is a pathogen, and nonspecific indications for its use should be critically evaluated.

SUMMARY

Pathologic changes due to epinephrine and norepinephrine can be classified into local and systemic changes. The local changes can be visually observed, and vary in severity with the involvement of deep supporting structures, and are preventable. The systemic changes are not generally recognized though apparently frequently present, even in the accepted therapeutic range. These changes involve numerous organs and have a profound effect on the cardiovascular system. Most of the changes observed in man can be reproduced in experimental animals and have a very similar gross and histologic appearance. The pathologic changes associated with pressor amine therapy are described and should be searched for and recognized in pathologic material. Some cases of idiopathogenic, ischemic, and hemorrhagic myocarditis probably can be attributed to pressor amine therapy. Central nervous system changes have been found to be extremely rare.

ACKNOWLEDGEMENT: The authors wish to express their appreciation for clinical cooperation and the furnishing of some of the material to Captain J. R. Connelly, MC, USN, Chief of Plastic Surgery, U. S. Naval Hospital; to the staff of the medical photography division, U. S. Naval Medical School, Bethesda, Md.; and for the technical assistance of Robert J. Sandidge, HM2, USN, and William H. Sellers, HM2, USN.

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DIET DURING LACTATION

The problem of lactation is one which is particularly important and often neglected. Obstetricians have a strong tendency to stress the importance of a good diet during pregnancy and to neglect to check the diet during lactation. Yet the daily accretion of tissue during pregnancy represents a much smaller nutritional stress than the secretion of large quantities of milk (850 milliliters milk corresponds to about 1,000 calories). The lactation period also usually represents a time of return to normal activity; in fact, very often it is a time of increased physical activity. In addition to previous commitments, the mother must take care of a small baby, so that caloric compensations by inactivity no longer occur. The pregnant woman could not ignore her physiologic state, especially during the last trimester of pregnancy, and "took care of herself" for fear of harming her unborn baby; however, the lactating mother has a tendency not to worry any more about her nutrition, even though she has to provide more protein, more calcium, et cetera. Too often she wants to get back "as fast as possible" to her prepregnancy figure. The physician must remember that the caloric requirement during lactation is dominated by the amount of milk output. For satisfactory lactation the increment over the normal intake should be not less than 800 calories per day.—Jean Mayer: Nutrition in Clinical Medicine: Calories. *Postgraduate Medicine,* February 1959.

HUMAN BEHAVIOR IN GROUPS

SAUL B. SELLS, *Ph. D.*

AN intrinsic aspect of human behavior in flight is that it involves the behavior of persons as members of organized groups in which there is some division of labor and differentiation of roles. As a result, each person must depend on others to some extent for the over-all accomplishment of his tasks. The in-flight interdependence of the crew members of bombardment, refueling, and transport aircraft is readily apparent. Similarly the co-ordination required among the solo-flying pilots of fighter-interceptor flights, with each other and with control stations on the ground, is easily recognized. The co-ordination network is greatly extended, however, by the participation of many specialized support agencies, such as maintenance, weather, airways and air traffic control, and others, when the operation is viewed in its totality. This thought was neatly expressed by an Air National Guard jet pilot[1] in the words, "You can't set a record by yourself," after a record-shattering F-86-F flight from Los Angeles to New York in 1954.

In recognition of the interdependence of human behavior in organized, group situations, terms such as teamwork, leadership, morale, and co-ordination have high status as desired values in human affairs. Systematic understanding of the behavior processes by which they may be achieved, however, has been slowly acquired and is as yet meager. It is gratifying that a vast amount of research effort is currently being directed at these problems and that some substantial results can be reported at this time. In selecting material for this report, precedence has been given to research actually concerned with the behavior of flight personnel in flight operations. As a result, only a few other references have been made to the substantial and growing research literature on group behavior or to the broader aspects of co-ordination involved in the operation of the over-all flight organization. Those desiring general references in these fields should consult works such as Cartwright and Zander's *Group Dynamics,*[2] Lindzey's *Handbook of Social Psychology,*[3] and McFarland's *Human Factors in Air Transportation.*[4] The Office of Naval Research[5]

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Presented in a symposium on experimental analysis of human behavior in flight at the annual meeting of Aero Medical Association, Washington, D. C., 25 March 1958.

issued a bibliography of unclassified research reports in group psychology.

With this limitation, let us consider first some semantic problems related to research in this field and a frame of reference to assist in organizing and interpreting the material to be presented.

SEMANTIC PROBLEMS

A great deal of confusion has resulted from the imprecise and often misleading use of terms related to group behavior, as for example, leadership and morale. One problem is related to their functional purposes. Such terms can have systematic explanatory meaning only when they refer to dimensions of group functioning, but they are often used to describe specific behaviors of individual group members.

Leadership, in an organized group, is the general function of facilitating the movement of the group toward the accomplishment of its designated goals; that is, of expediting group effectiveness. The behaviors of various designated persons, in this respect, must depend on the nature of the task, the people involved and the goals. Thus the leadership behaviors required of an aircraft commander, a squadron commander and, say, a hospital commander, may be quite different, and may also vary under different task conditions.

Similarly, *morale* represents attitudes associated with membership in a group, which reflect the cumulative satisfaction of group members derived from their participation in the group. It should not be confused with other concepts, such as general level of individual adjustment, although these are related. It cannot be specified by a particular list of behaviors, but rather depends on the relation of individual behaviors to the status of functioning of the group. Thus people in an organization might be happy, but either mission oriented and effective, or not, and evaluation of their morale would be different in these cases.

If a recent report by Fruchter, Blake, and Mouton[6] were taken at face value, one would conclude that leadership is highly, but negatively related to B-47 crew effectiveness, as rated by superiors and wing standardization boards. It is of interest that in this study the ratings of leadership were based on specified behaviors, principally of aircraft commanders, such as putting other crew members at their ease, making crew membership more enjoyable, and accepting responsibility. The authors themselves questioned the appropriateness of such behavior by a bomber commander to his military mission and cited similar results of a study of B-29 crews in combat, by Halpin.[7] However, Halpin used the more appropriate term, *consideration,* for the same behavior, which he, too, found to be negatively related to effectiveness ratings of aircraft commanders by their superiors. Halpin

properly referred to this finding as a "dilemma of leadership" inasmuch as the more the commander pleased his crew, the lower he tended to be rated in effectiveness by his superiors.

A similar finding was reported by Smith[8] in a study of B-17 groups based in England in World War II, whose mission involved the bombardment of heavily defended targets in Germany. Smith compared groups selected as highly effective and highly ineffective in terms of bombing results, and found that morale, defined as feelings of well-being and cohesion reflecting enjoyment of group participation, was low in the effective groups and high in the ineffective groups. On the other hand, in the most successful groups, cohesion was found, but it was centered around the mission, emphasizing military combat duties, rather than social and recreational activities. They were welded together with a common purpose, but this was to get their job done and get home. Group cohesion did not appear as an end in itself, and other purposes incompatible with the mission, such as safety and survival, were kept in check.

Smith concluded that superior performance in a combat bombardment group is more likely to be achieved if the designated leader (1) stresses mission objective over all other considerations; (2) is not himself overly identified with the personnel of the group to the point where this identification interferes with the mission; and (3) achieves a high degree of cohesion, confidence, and co-operation, but not necessarily "morale" in the sense of well-being. This ruthless emphasis on the mission was truly a "dilemma of leadership" which many combat commanders found too difficult to accept. It was dramatically portrayed in the play "Command Decision."

The work of Fiedler,[9] supported by the Office of Naval Research, throws further light on these problems. Fiedler's research, based on groups as diverse as high school basketball teams, student engineer surveying crews, and B-29 bomber crews, produced a number of consistent results. One of them related the group's perception of its mission to the attitudes of group members toward each other. For example, basketball teams that were high in league standing and competing for top honors tended to prize competency ahead of social participation, while low-standing teams placed more emphasis on "being a good fellow." These variations, which correspond with those observed by Smith, with respect to "morale" attitudes of B-17 groups, illustrate the importance of situational specifications in the study of morale.

With respect to superior-subordinate relationships, Fiedler emphasized the importance of the interaction between the two in relation to effectiveness. If the superior is outgoing and approachable and tends to get too friendly with his subordinates (that is, identify with them too much), he may find himself unable to make clear-cut decisions. If the organization has rigid

barriers between ranks and is part of a highly disciplined system, however, such a superior may be more effective. In contrast, an aloof superior who isolates himself from his subordinates may lose touch with the group. Such a superior, however, may be more effective in a situation where rank barriers are relaxed. Hence the relation of consideration, as a variable describing superiors' behavior, to group effectiveness should be expected to depend not only on the requirements of the mission but also on the nature of the group membership and group structure, as reflected in attitudes of group members toward each other.

The principal lesson in semantics that we can draw from this discussion is that in the study of group behavior a distinction must be made between terms used to describe human behavior, such as consideration, identification, co-operation, and terms used to describe group functions, which are essentially abstractions, such as leadership, morale, and group effectiveness. The task for psychologists and social scientists, with reference to the goal of clarifying the principles of group behavior, is to relate behavioral concepts to the abstractions of group function. Inasmuch as the problem is to explain group function in terms of behavioral data, it is essential that concepts of group function, such as leadership, morale, and group effectiveness, be employed to define criteria, while the predictions are based entirely on behavioral data.

Another important semantic point concerns the use of words to represent particular aspects of behavior. Throughout the literature in this field, terms are assigned to represent particular attitude, role, and behavior scales which are necessary for communication purposes but often imperfect symbols of the behavior described. Until a standardized taxonomy of behavior description is achieved, which at this time is certainly not imminent, extreme caution must be exercised in the comparison of results of different studies on the basis of the verbal symbols only, without reference to the supporting behavior descriptions.

FACTORS IN THE STUDY OF GROUP BEHAVIOR

All behavior represents the interaction of the person and the environment, in which significant variance can be attributed both to the abilities, habits, and dispositions of the person and the pressures and forces exercised on him by the environment. In group behavior, many of the significant environmental forces are derived from the structure of the group as it channels communication of information to various persons, defines prestige, power, and influence, and determines the roles that persons play in the concerted effort of the group.

The practical application of psychologic principles of group behavior in flying activities lies in the understanding of factors in organization and interpersonal relations that may be used to increase group effectiveness. From this point of view it becomes necessary to consider not only the characteristics of the per-

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sons who comprise group membership and the various aspects of group structure but also the purpose, goals, or mission of the group on which the concept of effectiveness depends.

There are, then, three dimensions of group functioning which interact and must be considered in interrelation in the study of human behavior in organized groups. Keeping in mind the practical application aspect, these dimensions may be regarded as subject to external control by top management, and this is reflected in the following terms which will organize the balance of this discussion: 1. Group goals define the mission in terms of the task objective set for the group and the priorities and cost limitations under which they are to be accomplished. 2. Group staffing defines the constitution of group personnel and therefore the upper and lower limits of their potentiality, in terms of the abilities and capabilities of the individual members. 3. Group utilization of personnel refers to the nature of the work environment provided for the group and hence it defines the extent to which the potentiality of the group may be realized.

The interrelation of these factors is illustrated in a very impressive report by Paterson,[10] who, although a radar control officer, was assigned by his station commander to attack the problem of a dreadful and destructive accident rate at a Royal Air Force fighter station during World War II. Available evidence suggested that the accidents represented careless errors of judgment rather than accident proneness, and Paterson approached the problem by efforts to increase group cohesion and to achieve a group norm of "good flying" for pressure to conform. After observing and analyzing conversations among pilots and other personnel, he decided that it was frustration of the desire to get into battle that was responsible for the prevalent irritability, carelessness, and lack of team spirit and that this might be overcome by giving the pilots something to fight, symbolic of the enemy. Since constant bad weather prevented the pilots from engaging the enemy in battle, the weather was on the side of the enemy and could be made symbolic of the enemy. The station might fight the enemy by fighting the weather.

The account of how he identified the respected, influential members of each group, whom he called exemplars, and working tactfully and unobtrusively through them, set in motion group interactions which gradually affected everyone on the station with a common purpose is one of the thrilling anecdotes of the war. In addition, in discussion of his successful efforts to reduce aircraft accidents, which have since been tested as well in industrial situations, Paterson made a number of important theoretical observations. With reference to team spirit and teamwork, he emphasized the importance of morale, based on appreciation of the common purpose and knowledge that everyone, in his role, is "doing his bit." Teamwork, the co-ordination of the various functions, depends on the development of such morale,

although "leaders or experts" are necessary to that co-ordination. But not only is it necessary to have one person tell others how to perform their functions. They also must know something of the way in which their functions are co-ordinated, which is the background to the popular interest in communication and liaison.

On *group structure* and *roles* he pointed out that:

> Not only was appreciation of functional coordination necessary, but also appreciation of the persons performing these functions; that is, estimation of role. . . . Function, hence role, has no meaning unless it is one of a structure of functions necessary to achieve the purpose of a group. . . . If a man performs no function of significance to a group, he cannot be a member of that group. . . . Thus at Bogfield, there could be no room for one who did not perform a function which helped in some way to put an aircraft and its pilot into battle with the enemy. . . . If the word "work" is taken to be synonymous with "job," then work may be said to refer to what a man does when what he does has functional significance, his contribution to the group activity. A man working fills a role. He and his role are identified and in this he becomes a meaning to society. . . . Unless there is a structure of functions work is not meaningful. . . . For a sense of belongingness, role, hence structure, is essential. . . . Belongingness gives security.[10]

Thus we can see that behavior of persons as members of groups and their collective behavior in groups reflects the complex interaction of many variables which we have grouped logically in the three categories: group goals, staffing, and utilization. The research summarized in the remainder of this discussion illustrates a number of variables related to staffing and utilization. In each case, however, the results must be interpreted with reference to the established goals of the particular group and the particular perceptions of them found among the members of the groups, as well as with reference to all other conditions of staffing and utilization not specifically isolated for study. The fact that relevant variables are not always taken into account by investigators does not alter their relevance or effectiveness.

CRITERIA IN MEASUREMENT OF GROUP PERFORMANCE

One of the most baffling and elusive problems in personnel research has been the development of appropriate, reliable criteria of performance. Measurement of group performance is necessary to evaluate the effects of various factors presumed to account for group performance.

Research, primarily with B-29 crews by the Combat Crew Training Research Laboratory at Randolph Air Force Base, has given a rather discouraging picture of a number of objective indicators of bomber crew performance. For example, Forgays and Irwin,[11] who studied 600 B-29, student crews in training, reported results such as the following:

Radar bombing circular errors obtained by the radar bomb system (RBS) showed a corrected odd-even mission reliability of .33. Attempts to increase reliability by correcting for target and mission differences, presence of instructors, and condition of radar set were unsuccessful.

1. Mean circular errors on the ultrasonic (ground) trainer had a reliability of .47, and questionable validity in relation to radar bombing scores in flight.

2. Target identification scores on simulated visual bombing missions ("visual camera" scores) had a reliability of .20, which was believed to be inflated by instructor estimates in scoring. Circular errors in actual visual bomb drops had a reliability of 18.

3. Average errors in making good control times showed a reliability of .49, with some indications requiring verification, that these errors relate meaningfully to mission difficulty and stage of training.

4. Ground school written examination had relatively high Kuder-Richardson reliabilities (.60 to .91) in the cases examined, but these failed to correlate meaningfully with objective in-flight measures.

These results are representative of efforts to obtain satisfactory objective measures of flight crew performance. On the other hand, ratings of crews by superior officers and by standardization boards have proved reliable in a number of studies, although not related to objective measures. Knoell, French, and Stice,[12] for example, obtained several types of ratings on combat performance in the Far East for 108 B-29 crews which had trained initially at Randolph Air Force Base. Their results showed:

1. That ratings by squadron commanders and, in some cases, wing officers, were satisfactory as to inter-rater agreement. However, although nine dimensions were rated, factor analyses revealed that they were accounted for by one general factor.

2. That similar ratings of individual performance were most satisfactory for aircraft commanders, navigators, radar operators, and flight engineers, ratings of copilots, bombardiers, radio operators, and gunners did not reach satisfactory levels of agreement.

3. That ratings of flight crews by ground crews assigned to their aircraft offer a reliable source of rating information, although these ratings did not correlate significantly with anything else.

In view of their demonstrated reliability and authoritative status in the operating affairs of the organization, superiors' ratings have in one or another form been used in most of the research known. This is probably more expedient than satisfactory, however, and the criterion problem remains an important and challenging area for continuing investigation.

RESEARCH ON STAFFING PROBLEMS

Technical Competence

The most important single factor controlling the assignment of personnel to any flight crew is technical competence. Although, from the standpoint of crew effectiveness, the possession of a minimum standard of technical competence may be regarded as a necessary rather than sufficient requirement, the study of Fruchter, Blake, and Mouton[6] reported a positive, linear correlation of .43 between crew members' ratings of each other on this factor and the superiors' rating criterion. These ratings were based on such items as frequency of errors in the air, competence and interest in technical specialty, satisfaction with performance in both air and ground activities, and consistency of performance.

There is some impressive evidence, from another study of B-47 crews, that crew members' approval of the technical competence of other crew members is not entirely a matter of individual proficiency, but also depends to a substantial degree on their experience in working together. Hood and his associates[13] found that crew agreement on "who does what when" in flight, which is highly correlated with superiors' ratings, is a direct function of crew members' experience in flying together; the important factor is neither flying experience nor even multi-jet time *per se*, but experience together as a team. The importance of operational training to supplement initial crew assembly is clearly indicated and neatly illustrates the interdependence of staffing and utilization measures.

Crew Assembly

The problem of rational crew assembly has received considerable research attention and yielded useful results. Rational approaches imply that some combinations of personalities, backgrounds, skills, and other individual characteristics may be more compatible and adaptable to effective task performance than others. The literature on interpersonal attraction and selection of mates and work partners is relevant and has contributed to approaches which have been investigated. A comprehensive review by Haythorn[14] cited a number of generalizations as well supported by experimental evidence:

> 1. Research on crew composition and efforts to assemble crews for optimal performance has confirmed that variations in crew effectiveness can be accounted for by variations in the particular combinations of individuals composing the groups.[15]
>
> 2. The most successful method of assembling crews thus far has been that of self-selection, in which crew members express their own choices of preferred crewmates. The improved effectiveness obtained by such methods is apparently a result of increased crew compatibility observed in crews composed by these methods. A limitation of self-selection methods has been their feasibility, but this is less of a problem with smaller crews such as in the

B-47 and B-52 type aircraft, as compared with the much larger B-29 and B-36 crews. To accomplish self-selection, it is necessary to give potential crew members an opportunity to become acquainted with those from whom they are expected to choose. The more extensive this acquaintance, the more effective the assembly procedure is likely to be. Practical procedures for setting up contact situations have been described by Roby and Rosenberg.[16,17]

3. One of the most important determiners of compatibility among crew members is similarity of values regarding issues relevant to group performance. Hence, compatibility and resulting efficiency can be improved by assembling in the same crews individuals whose values and attitudes on mission and work-related issues are alike. The more relevant the issue, the more important this sharing of values becomes.

A recent unpublished study by Sells and Templeton,[18] which was concerned with the problem of reducing attrition in primary flight training by compatible matching of students with flight instructors, also showed how individual needs may influence choice. When asked for preferences as to students, the instructors' replies included such statements as, "I prefer to have no students taller than 5 feet 6," and "I would prefer non-college graduates." Among the students' replies were preferences for "older, more patient, and fatherly" instructors and for instructors "who don't chew you out on the radio." It was not clear whether the satisfaction of such expressed choices or increased compatibility resulting from it was effective in the significant reduction of attrition accomplished in this study.

In a related study using basic airmen as subjects, French[19] studied the influence of achievement and affiliation needs, measured by psychologic tests, on work partner selection. She assumed that the behavior of a person making a choice between a work partner who was a competent non-friend and one who was a less competent friend could be predicted by the relative strength of these two kinds of motivation. The results were in accordance with the hypothesis, although subjects low in both achievement and affiliation showed no patterning. In addition, the achievement motivation mean scores showed a significant increase and the affiliation a significant decrease from subjects who chose a friend, through those who chose both the friend and the competent person, to those who chose the competent person only.

The accomplishments of research on crew assembly problems warrant further support of effort in this direction, as well as practical application of technics already available. The refinement of technics using proficiency measures and personality test profiles, following up promising beginnings referred to above, and the use of mathematical models[20,21] need to be investigated. The methods developed in this field also will have application to the development of other significant work groups in aircraft and missile operations.

RESEARCH ON UTILIZATION PROBLEMS

The challenge to top levels of control in an organization is not only to obtain the best talent for the required tasks, but also to make the most effective use of it. This is the strategy of the term utilization, which implies the exploitation of all possible relevant factors in the work environment that may contribute to group effectiveness. Of course, there must be a balance between goals, capabilities, and facilities. If the goals are unrealistically high or low in relation to the other two, certain problems will arise. Or, if either the personnel or facilities are inappropriate to the goals, there will be other problems. A commonly overlooked problem, however, is that of an organization in being, with qualified personnel and generally reasonable goals, which falls short of optimal effectiveness and has room for considerable improvement. Let us examine the relevant factors for improvement of utilization.

Aircrews and other organizations have been approached by different investigators in terms of several different conceptual viewpoints. One approach, which has been used more in relation to larger groups such as squadron, wing, and larger administrative units, is concerned with organizational structure, lines of authority, communication channels, span of control, pay, promotions, and other formal, structural aspects of the system. This may be called the structural approach. A second approach views a crew or other group as a social group, which is part of a social system. The sociocultural background provides a common set of symbols to which the members respond. The members are differentiated in terms of roles, status, power, and various patterns of interrelation which affect and are affected by each others' attitudes, interindividual compatibility, co-operation, and performance. The emphasis here is on group dynamics. Finally, the third approach looks at an aircrew as a man-machine system. It is task-oriented and involves a flow of communications in relation to group (actually system) work output.

Although each of these approaches has been productive, no one is alone sufficient to the total problem. Indeed, there is no reason to expect that the picture of an organization from the viewpoint of group dynamics, the analysis of formal structure, and the man-machine system need be consistent. Whether the effects of different aspects are complementary or contradictory may be important in many cases. The interplay of various factors can only be evaluated by a comprehensive, integrated approach. At present, however, we must be content to consider the contributions of the separate approaches.

The Structural Approach

Important contributions from this approach have come from the Ohio State University leadership studies, which have received support from the Office of Naval Research and the Air Force. The profound importance of the formal structure and its

implications for the behavior of organized groups was graphically analyzed by Stogdill.[22] The act of organization involves specification of jobs and their functions in the over-all division of labor. The specification of a job constitutes definition of responsibility to whom, for what functions, and incidentally at what level of prestige, status, and power. Thus the official lines of authority and communication, power and status hierarchies, and the basic prescriptions of roles in the group are specified by the formal structure of the organization. They may contribute positively to effective operation or interfere.

Responsibility, however, can never be spelled out in complete detail nor is this desirable. A proper balance must be struck between the dangers of ambiguity at one extreme and of excessive restraint and red tape, at the other. Behavior within the organization occurs according to *expectations,* resulting partly from custom and tradition and partly from interactions between superiors and subordinates within the organization. Conforming expectations reflect favorable goals, formal structure and personnel capabilities, reinforced by effective discipline and exemplary behavior by superiors; while deviant expectations and nonconformity, which impedes and may undermine the organization, may result from unfavorable conditions or lax discipline and deviant examples by superiors and high status persons. To the extent that superiors are conscientious about influencing conformity with organizational patterns, their own freedom of behavior is sharply restricted.

Conformity with expected behavior of a particular job, or assumption of expected role in accordance with the prescribed formal structure, often produces unintended behavioral results of far-reaching significance. The traditional unpopularity of the inspector and of the comptroller in large organizations is virtually written into their job descriptions and intensified when conscientiously followed. Departmental rivalries, "empire building," budget padding, and similar bureaucratic institutions can be shown, to a large extent, to be inherent in the basic formal structure of an organization.

Research on role behavior of members of aircrews[23-25] has generally confirmed these principles in both student and operational B-29 crews, both with respect to the interaction of aircraft commander behavior with crew interpersonal relations and expectations, and relation to crew proficiency and combat effectiveness ratings. Torrance[26] has shown the influence of power position on group decision making in B 26 crews, and his results, like those of Hood and associates[13] in the B-47 study mentioned earlier, have emphasized the importance of training together in supporting and solidifying a "crew norm" of operating procedure.

Another important contribution from the Ohio State University group is Hemphill's[27] development of a taxonomy of situational

factors in group situations which have behavioral implications and which can be measured by his "Group Dimensions Description Questionnaire." Examples of his dimensions are group autonomy; control over activities of members; flexibility of procedures; stratification by rank, authority, prestige; stability of personnel, assignments, and organizational structure; and affect associated with membership.

The Group Dynamics Approach

Although the formal structure of an organization has a profound influence on roles, attitudes, and behavior, this influence is exercised through the reactions and interactions of people in the group. In addition, many interactions occur in the form of group pressures and group standards, reflecting patterns of cohesiveness and communication among group members, which are not directly related to the formal structure. Actually, the formal structure may be considered as a plan, whether spelled out in detail or implied, and an organization in operation seldom corresponds with the organization model as charted.[2, 22]

Group dynamics is reflected by the intervention of human social factors interacting with the formal plans and other influences in the situation. The resulting work performance, attitudes, and relationships among members reflect the organization in operation. In his efforts to make the actual organization conform to the formal plan the appointed leader is continually confronted with the task of reconciling discrepancies between what should be done and what is done, between the needs of the organization and the needs of individual members, and between prescribed and actual lines of communication. Many of the most important decisions he faces involve compromises between maximum goal achievement and the costs they imply in terms of risks of jeopardizing the organization by impairment of the welfare, motivation, and capabilities of its members.

In their introduction to the problems of group pressures and group standards, Cartwright and Zander[2] quoted Bill Mauldin's[20] book *Up Front* in which he stated that combat outfits "have a sort of family complex." That is, the men know what is expected of them and readily accept group pressures to behave in a certain way while they are group members. Mauldin stated:

> Combat people are an exclusive set, and if they want to be that way, it is their privilege. They certainly earn it. New men in outfits have to work their way in slowly, but they are eventually accepted. Sometimes they have to change their way of living. An introvert or a recluse is not going to last long in combat without friends, so he learns to come out of his shell. Once he has "arrived" he is pretty proud of his clique, and he in turn is chilly to outsiders.[20]

This quotation illustrates identification. One of the concomitants of identification involves acceptance of group norms which

function as pressures to conform. This is part of the explanation of the importance of communality of values in a cohesive group. Except in the relative isolation and intensified stress of the combat group, where situational pressures and survival needs may obscure other affiliations, however, most people affiliate with many groups which exercise various pressures on those who identify with them. Religious, social, political, and other group memberships not only represent basic values, but also styles of living, likes and dislikes concerning a wide range of activities, and prestige, status, and resulting power and influence among associates.

Some of these, which have equally important civilian counterparts, are illustrated by military status categories such as rank (flag, field grade, company grade, warrant, noncommissioned officer, and enlisted), type of aircrew rating, regular versus reserve, and Academy graduate versus other. The importance of such status categories is clearly shown by the many symbols of status that are displayed and coveted, such as insignia, distinctive wings, flags, badges, parking spaces, office furniture, rugs, desk sets, private dining rooms, cars, clubs, and the like. These are not merely utilitarian conveniences, but also means of reinforcing and displaying evidence of power, prestige, and status, which have implications for the behavior of their owners and their associates.

In a formal organization in which authority is hierarchical, co-operation is enhanced when the various dimensions of status are consistent throughout the organization. Top management of an organization might well investigate many of its existing status conventions, if it is desired to exploit fully these informal forces within the group. For example, Lanzetta and Haythorn,[29] in a study of B-29 instructor-crew influence on student attitudes and performance, found a decided lack of prestige attached to instructor status. In view of the well-known influence of prestige persons on attitudes of their associates, and of the demonstrated relations of crew attitudes to crew effectiveness,[25, 30, 31] the possibility of positively affecting attitude development among student crews by improving the prestige status of instructors appears a worthwhile problem.

The effects of various forms of *interaction among aircrew members* have been studied in relation to crew effectiveness. DeGaugh and Knoell[30] found a significant relation between a factor which they called "pride-in-work-group" and superiors' ratings of 89 B-29 groups in combat. The items which identified this factor were chiefly related to liking members of one's crew, satisfaction with the accomplishments of the crew, and a sense of safety in flying with the crew. Haythorn[25] reported significant correlations for 103 B-29 crews which indicated that crew mean sociometric scores covary with crew mean attitude scores, particularly on the same dimension of pride-in-crew, and with combat

ratings of the crew by superior officers. In a later study of 42 B-29 crews which remained together from training into combat in the Korean War, Knoell[31] reported that crew attitudes measured in training and also in combat are significantly correlated with the crews' rated combat performance. The same interpersonal factors as reported in earlier studies, namely, pride-in-crew, acceptance of Air Force goals and sense of well-being in the Air Force, which reflect group acceptance of the same task-oriented values, were reported by Knoell as criterion related.

The relations between superiors and subordinates, particularly between the aircraft commander and the combat crew, which have been studied most in the flight situation, are significant in achieving the attitudes which are most compatible with effective performance. These relations are subtly dependent on the nature of the task and the mission. Although no empirical data are available, it is likely that the negative relation to effectiveness of consideration and nurture by the aircraft commander among combat crews, as reported by Fruchter, Blake, and Mouton[6] and Halpin,[7] might be positive among commercial aircrews whose duties are less hazardous and stressful. In his role on the crew, the aircraft commander is the source of information which affects the performance and sense of individual security on the job of his subordinates. He must keep his crew informed, but the nature and purposes of his communications will be conditioned by the requirements of the situation.

Research on group dynamics has repeatedly emphasized the importance of *communication of information* necessary to the group for feelings of individual well-being and effective performance.[32,33] For example, Riecken[34] described a work camp group where the behavior code prohibited criticism or aggression of any kind. As a result, the usual minor antagonisms and conflicts enlarged, because they could not be discussed, until the entire group lost its cohesiveness and effectiveness. Cartwright and Zander[2] pointed out that international conferences and workers at noisy jobs both suffer loss of effectiveness and cohesiveness as a result of communication difficulties unless compensatory mechanisms for communication can be obtained. Taylor[35] found a highly effective functioning communication system in an Air Force squadron which was independently rated outstanding.

In an extensive study of a mental hospital, Stanton and Schwartz[36] noted the formal organization structure and from it constructed a chart of the "formal expectation of the transmission of information," which carried a small but vital part of the communications among the staff to higher administrative levels. They repeatedly observed the causes and effects of the "blocking" of this type of information: Blocking was usually due to the overloading of these formal channels or to changes desired or not desired in hospital procedures. The effect was the setting up of informal channels to carry needed facts. The informal chan-

nels usually were slower, less accurate, and more misleading, but eventually a needed bit of information reached the person who needed it, although frequently too late or too inaccurately for effective action.

Stanton and Schwartz also found that the informal channels could be roughly predicted from a chart of the formal expectation of communication, once the location of the block of formal channels was known. Furthermore, the informal channels were unstable, due to their excessive length and unreliability. They would form, then break up, then reform repeatedly until the blocked formal channel was reopened. The persons used as intermediates in the informal channels became noticeably tense without realizing why, while the two primary persons concerned were constantly seeking newer and better informal channels. Whenever a block in the formally expected line of communication between staff members was removed, considerably improved behavior was noted in patients dependent on the persons involved, although these patients had not been directly concerned.

These authors cautioned against confusing lines of formal authority with the formally expected channels of communication. Forcing the use of the former for all formal communication quickly leads to blocking due to channel overloading, and this in turn leads to the establishment of informal or even *sub rosa* channels, which are much less effective methods of communication. Thus communication should not follow but actually reinforce the formal organization through a network of expected communication derived from formal job descriptions. This conclusion is supported by centuries of combat history; men in actual combat must communicate not only with their superiors to the rear but also with the groups on their flanks.

The more existing channels of information support the formal organization, the more they reinforce the positions of the leaders and decision-makers, and the less likely will there be discrepancies between formal and informal power structure.

Man-Machine System Approach

It is possible, as some investigators have shown, to ignore structure, status, roles, and interpersonal problems, and to regard an aircrew or other task group as a system in which crew members and equipment are linked and information must flow efficiently to enable decisions and responses in appropriate sequence and timing. This approach is concerned with discovering the most efficient arrangements for information flow for various types of group and task.

A simple model illustrating this problem is given in a study by Bavelas,[37] who demonstrated experimentally that different forms of communication structure have differential effectiveness in group performance. He arranged five cubicles into each of several geometric configurations, such as a star, a fork, a circle,

and a straight line, and then placed a person in each cubicle. Each was given a bit of information, which together with the other four bits of information given the others constituted solution of the problem. The geometric pattern markedly affected the assembling of the bits of information: Highly centralized figures, such as the star and fork, organized faster, were more stable from problem to problem and test group to test group, solved problems faster, and evolved as leader the centrally placed persons. The flow of information could thus be seen to be an important resultant and determinant of how well a group functions.

Roby and Lanzetta[38-40] investigated task performance in the laboratory under four different conditions of communication structure, ranging from that in which control agents had direct access to none of the information required to operate their own controls to that in which control agents had direct access to information for all but one of their controls. They found that differences in team performance are associated with task communication structures even within the comparatively narrow range of the structures studied. Performance efficiency increased as the structure permitted more direct transmission of information and less dispersion. Learning was more rapid with an easy communication system than with a difficult one, and replacing an interphone circuit with a telephone circuit resulted in wider differences in performance and an increase in errors.

These and related studies have suggested a number of principles of job structure to maximize group performance in a man-machine system. These are (1) load-balancing, wherein each member of a team is equally occupied in attaining the goal, regardless of the importance or magnitude of the contribution or of variations in type of activity; (2) autonomy of function, which implies that jobs are self-contained with reference to information necessary for their performance; and (3) homogeneity of function, wherein the functions performed by each job have a high degree of homogeneity with respect to information handled.

These principles have implications for technical competence and therefore for the content of selection and training programs, as well as structure of the organization. The Roby and Lanzetta studies have shown that when they are violated to various degrees by varying the proportions of information-giving and relaying requirements, decrements of performance resulted.

In a study by Voiers[41] of factors involved in bombing accuracy in B-29 crews, it was found that the aircraft commander and radar observer were directly dependent on one another for effective expression of their respective proficiencies. The proficiency of each member (as measured in ground school) correlated most highly with the bombing criteria under conditions of higher-than-average-proficiency in the other member. High proficiency in the navigator appeared to compensate in some degree for lack

of proficiency in the aircraft commander and radar observer, in that the navigator's proficiency appeared most highly correlated with the criteria under conditions of low proficiency in these members. The results for bombardiers were inconclusive. Voiers interpreted the relationship between bombing accuracy and the proficiency structure of the bomb team by means of a crude electrical analogy in which the proficiencies and performances of the aircraft commander and radar observer were represented as being "in series" with one another and collectively "in parallel" with the proficiency-performance of the navigator. These observations fit in nicely with the principles of load balancing, autonomy, and homogeneity of function.

SUMMARY

In a survey of research on group behavior oriented to problems of aircrew proficiency, a common semantic problem was clarified which involves the distinction between terms descriptive of behavior and those descriptive of group functioning. This was illustrated with reference to the terms leadership and morale. The survey was organized in terms of a frame of reference within which top management levels might consider application of principles of group behavior to increase group effectiveness.

The concept of effectiveness depends on the specification of group mission or goals, which is necessary in order to define criteria of performance. Group performance in relation to goals depends on staffing and utilization of personnel. Staffing refers to capabilities of group members and hence the group potentiality. Methods of crew assembly were reviewed under this heading. Utilization refers to the work environment provided by management for the group, and therefore reflects the extent of realization of potentiality. Approaches to utilization considered were the structural approach, group dynamics, and the group as a man-machine system. Each of these provides a partial view of the total problem and although substantial insights have been reported from each approach, their integration into a comprehensive analytic system is required. The profound influence of group behavior factors in aircrew effectiveness recommends consideration of both military and civilian programs of immediate application and continued support of research.

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TREATING THE WHOLE PATIENT

As physicians, we must learn to treat each patient as a whole—not as a fractional man, but as a person with a body that senses pain, a mind that wrestles with fear and anxiety, and a soul that will never be completely cured until it has been made one again with God. It is a grave mistake to treat the body and the mind, however wisely, while neglecting the person himself. It is our job to help the patient die in peace if he cannot get well, but if he can survive, to send him home to his family and work able to resume his place in the community and ready to attest to what *both* science and his faith have done to make him whole again. Anything short of this does not constitute healing in the highest sense of the word.—Craig D. Ellyson: A General Practitioner Evaluates the Problem of Treating the Whole Patient. *Journal of Iowa State Medical Society,* September 1958.

PULMONARY INFARCTION COMPLICATING SEGMENTAL RESECTION

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AT the present time, the mortality rate following pulmonary resection in the treatment of tuberculosis is very low indeed—an impressive and highly favorable rate never considered possible a few years ago.[1] Such imposing results, however, are not evident when untoward morbidity and complications following resectional therapy are analyzed. The magnitude of these problems is reflected in the voluminous literature, which has appeared since 1946, dealing with postoperative complications.

Early in 1954, one of us (J. M. S.) was impressed by the gross appearance of a subsegment of pulmonary parenchyma, seen at secondary thoracotomy, which had the gross characteristics of infarcted tissue; this subsegment comprised approximately half of the raw surface of the remaining anterior segment of the right upper lobe following apical and posterior segmental resection of tuberculous residuals 10 days previously. Numerous alveolar air leaks, producing a tension pleural space and prompting the secondary thoracotomy, were visualized over the irreparably devitalized subsegment of lung; an intersegmental vein coursing over the infarcted lung was thrombosed without evidence of proximal ligation; incision into the discolored subsegment produced no bleeding. This necrotic lung tissue was easily removed from the underlying normal subsegment, by traction and blunt dissection, down to the subsegmental bronchus which was divided and closed; no appreciable surface air leaks were then evident, after which a limited modified thoracoplasty was performed, with underwater-seal pleural drainage. Subsequent recovery was uneventful. The pathologic diagnosis was "infarction of lung tissue; no evidence of a specific granulomatous process."

From Fitzsimons Army Hospital, Denver, Colo.
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Since becoming aware of this problem of localized postresection infarction of the lung, 399 additional segmental resections have been performed at Fitzsimons Army Hospital. Following these procedures, 14 patients, or 3.8 per cent, have developed complications, similar to those related above. Apparently, this pathologic entity has not occurred in the experience of many thoracic surgeons or has progressed to the stage of bronchopleural fistula, empyema, or hemorrhage before secondary corrective surgical measures are undertaken.

During this four-year period, we have become increasingly familiar with the clinical and roentgenographic characteristics of this postoperative complication, and with the method of management we consider proper when such difficulties arise. Suggestions as to prevention will be presented.

REVIEW OF THE LITERATURE

In regard to the surgical anatomy of the pulmonary vasculature, Appleton,[2] in 1944, was impressed with the degree to which segments of the right upper lobe were supplied by trans-segmental arteries. In 22 per cent of 50 cases in his study, the posterior segment was supplied by recurrent branches of the apical segmental arteries. In 8 per cent, the posterior segment was fed in part by branches of the anterior segmental arteries. Similarly, the apical segment received its blood supply partially from rami of the anterior segmental artery. The anterior segment received additional branches from either the apical or the middle lobe arteries in another 8 per cent of specimens. From such findings, it may be concluded that the possibility of impairing the anomalous arterial blood supply to an isolated upper lobe segment is not insignificant. In addition, Appleton was the first anatomist to relate the pulmonary veins to the intersegmental surface and speculate upon their surgical significance.

Unfortunately, the understanding of the pulmonary vasculature is beset by the difficulty of multiple terminology and various investigators have attempted to improve the situation in different ways. Overholt and co-workers[3] suggested that the venous drainage of the bronchopulmonary segment consisted of lobar veins having both segmental and intersegmental tributaries. Boyden[4] felt that this was oversimplification but surgically significant in dissection of the intersegmental plane.

The technic of segmental resection was gradually perfected after the anatomic concept of the bronchopulmonary segment was advanced. In 1939, Churchill and Belsey[5] reported the employment of this technic in the surgical treatment of bronchiectasis, the underlying aim being to preserve as much normal lung tissue as possible. Clagett and Deterling[6] also adapted this technic

to the lingula for the treatment of bronchiectasis. The first significant series of segmental resections in the management of pulmonary tuberculosis was reported by Chamberlain and Klopstock,[7] in 1950. They recorded 72 cases so treated and were encouraged to continue its use, noting that there was a decided decline in the number of postoperative complications as their technical skill and postoperative care improved.

Clagett,[6] appreciating the anatomic concept of the bronchopulmonary segment, applied the "traction" dissection technic, beginning at the hilum; a method, with slight modifications, employed by most thoracic surgeons today. Initially, Clagett infolded the raw surface area, a procedure which apparently led to numerous complications. Overholt[3] left the segmental surface open and allowed the lung to "breathe."

Chamberlain and Klopstock[7] cautioned in regard to the dissection of the left upper lobe hilum noting that there was often an anomalous arterial supply to the anterior segment arising from the parent artery to the apical segment as described by Appleton[2] and Boyden.[4,5] They pointed out that ligation of such vascular structures, before proper identification, might lead to serious complications. These investigators also clearly visualized the intersegmental veins as receiving tributaries from both sides of the intersegmental plane and advised careful dissection and preservation. Chamberlain and Klopstock also suggested that "it is a good general rule to delay the division of any vein until absolutely necessary."

Most of the experimental work in the pathogenesis of pulmonary infarction has dealt with embolization or ligation of the pulmonary arterial tree. Although infarction of pulmonary tissue may occur in the presence of sudden occlusion of a large pulmonary artery in a healthy animal, it is not the usual course of events.[9,10] It is well established that any condition leading to the production of serious venous stasis predisposes to subsequent infarction of arterial origin.

Ameuille and co-workers[11] were concerned with the character of collateral circulation developing in the presence of pulmonary venous ligation. Only 4 of 10 dogs survived his intrathoracic procedure and these were sacrificed at intervals up to 7½ months after which injection studies revealed marked vascularization of the overlying pleural palque, opposite the operative site, forming collateral venous channels. Such a mechanism of venous return is absent in a nonexpanded isolated segment such as occurs in complicated segmental resection. In 1938, Reinhoff,[12] in describing a two-stage technic of pneumonectomy for broncho genic carcinoma, referred briefly to the danger of inadvertently

ligating the superior or inferior pulmonary veins. He suggested this could lead to moist gangrene. He cited, however, no specific cases and did not speculate upon the pathogenesis. Brantigan,[13] and Kent and Blades,[14] in discussing the anatomy of the pulmonary lobes, implied that gangrene might result if the venous drainage of the related lobe was interrupted. In 1948, Swan and Mulligan[15] did experimental ligation of pulmonary veins in dogs. Pathologic study revealed severe fibrinopurulent pleuritis with vascular adhesions, intense hyperemia, hemorrhage and edema of the alveoli and bronchioles, and increased susceptibility to infection. They noted thrombosis of the veins but did not observe extensive tissue necrosis. They concluded that, in spite of the initial congestion and alveolar hemorrhage, the lung eventually recovered with approximately a 20 per cent decrease in functional capacity. Perhaps in these experiments, the rapidly developing vascular pleural plaques bridged the gap preventing acute lobar pulmonary venous insufficiency. Wyatt and co-workers[16] conducted a similar canine study and noted the importance of antibiotics (penicillin) in preventing severe postoperative infection predisposing to infarction. They were impressed with the extent and vascularity of the pleural plaque and commented upon its significance in establishing collateral circulation. These investigators described small fibrous nodules scattered throughout the healed areas in the pulmonary lobe and speculated upon their pathogenesis without considering them healed infarcts.

In 1951, Stemmermann, Daniels, and Auerbach[17] ascribed the pathogenesis of bronchopleural fistual, following excisional therapy for pulmonary tuberculosis, to pre-existence of disease in the pleural space at the time of surgery. The resultant empyema spread to the bronchila stump with subsequent breakdown and fistulous formation. In 1952, Zelman, Davidson, and Ulmar[18] reviewed 200 cases of pulmonary tuberculosis submitted to surgical resection and found that necrosis of the lingula occurred in 1 case following segmental resection. Steele, Narodick, and Cadden,[19] in 1953, remarked that the disadvantage in the performance of small resections for pulmonary tuberculosis was the high incidence of postoperative complications. Although there was no mortality and the end results were good, 20 per cent of patients developed persistent lung leaks, hemothorax, or empyema. There were, however, no tuberculous complications. In the presence of such leaks, they advocated that it was better to perform a secondary thoracotomy than to persist in the prolonged use of drainage tubes. Bell,[20] in 1955, discussed the postresection space complicating segmental and wedge resection. He reported 61 complications in 308 resections, an incidence of

20 per cent, and noted that the location of the persistent space was usually at the operative site. In his experience, most localized pneumothoraces responded to underwater-seal drainage within 2 weeks; a small number, however, became chronic problems with pyogenic infection. He concluded that the occurrence of such complications did not significantly influence the future status of the patient's tuberculosis. Douglass, Bosworth, Judd, and Chang,[21] as all of us, had some experience with late leaks or pneumothoraces occurring 2 to 10 days after removal of intrapleural tubes. They used the term "alveolo-pleural fistula" and remarked that a distinction between this problem and bronchopleural fistula should be made. Corpe, Shek, and Cope,[22] in 1956, reviewed 182 segmental resections performed for tuberculosis, and noted that air leaks in the postoperative period accounted for more than half of the total number of complications. Twenty-two patients having pleural spaces required further therapy. Of these, three developed bronchopleural fistulas, empyema subsequently developing in one. Nine of the patients were treated by re-insertion of pleural catheters and 12 by post-excisional thoracoplasty. Final results were considered to be excellent; however, they were unable to make recommendations which might decrease the significant postoperative morbidity rate. In 1955, Findlay,[23] while a member of the Thoracic Surgery Staff at Fitzsimons Army Hospital, became interested in our studies on postoperative pleural space problems and was convinced that postresection pulmonary infarction does occur and, not infrequently, is the sole cause of the residual pleural air pocket which may persist and progress to other complications of a more serious nature, if not promptly and properly treated. In 1956, he reported that a persistent pleural space following partial resection of the lung may lead to bronchopleural fistula months later, and advised early reoperation at which time the visceral pleura is not thickened with fibrosis, and the lung is still expandable. One of us (J. M. S.)[24] reported on some of our early experiences and opinions on "postoperative infarction of the lung" in the Eighth Annual Symposium on Pulmonary Diseases—Fitzsimons Army Hospital, 1955.

CLINICAL FEATURES AND OBSERVATIONS

The complication of pulmonary infarction following segmental resection for pulmonary tuberculosis occurred fifteen times in 400 procedures performed on 371 patients during the period of January 1954 to February 1958. This difficulty involved 7 males and 8 females with an average age of 28 years. All except 3 were Caucasian. The average duration of tuberculosis diagnosed prior to surgery was 15.4 months, the longest being 5 years and the shortest 7 months. The period of chemotherapy prior to surgery

averaged 7.4 months, the longest course being 15 months, in 3 cases 6 months, and in 1 only 1 month. Chemotherapy primarily consisted of isoniazid, para-aminosalicylic acid and streptomycin in varying combinations. The average duration of negative cultures prior to surgery was 6.8 months, the longest being 12 months and in 1 it was only 3 months. One patient who had never shown positive cultures received 1 month of preoperative chemotherapy.

The surgical description of the adjacent segments remaining at the conclusion of surgery revealed no palpable disease in 8 cases. Five had a definite nodular fibrotic consistency to palpation and 2, upon dissection of the hilum, revealed anomalous vessels. In 9, there was either severe fibrosis obliterating normal tissue planes or nodular disease within the intersegmental plane. In 1 case, a small cavity was opened along the intersegmental plane and this was the patient who exhibited a late tuberculous pseudopulmonary cavity of the type described by Bell and Medlar.[25] Review of the operative reports revealed no technical difficulty in 9 cases although in these patients there was frequent mention of ligation of venous channels and oversewing of leaking segmental surfaces. In the remaining 6 cases, the dissection was described as difficult, requiring sharp procedures and wedging across the intersegmental plane (see table 1).

Pathologically, all specimens obtained at the first procedure revealed cavitary disease except four which consisted, primarily, of healing necrotic foci. Two cavities were considered to be inspissated while three were reported as "healed." In one there was histologic evidence of progressive disease. The tissue removed at the original procedure usually consisted of the apicoposterior segment of the upper lobe, there being seven such procedures on the left and three apical and posterior segmentals on the right. Of the remaining five, two consisted of removal of only the posterior segment of the right upper lobe, the posterior subsegment of the left upper lobe, the apical segment of the right upper lobe and finally a left upper lobe equivalent. When pulmonary infarction complicated the segmental procedure, it always occurred in a segment of which one segmental plane was involved in the dissection procedure. Thus, the anterior segment was the commonest such segment involved, being adjacent and exposed in 10 procedures. The three posterior segmental resections subsequently involved subsegments of the apical segment. The one case in which apical resection was performed involved a subsegment of the anterior segment and, finally, following removal of the left upper lobe equivalent, infarction occurred in the lingula.

TABLE I. *Infarction complicating segmental resection for pulmonary tuberculosis*

Case No.	Age, race, and sex	Adj. remaining segment (*)	Intersegmental plane (*)	Surgical difficulty (*)	Segments removed (*)	Space occlusion (*)	Segment infarcted	Interval (*) (days)	Appearance at reoperation (*)
1	24, W, M	Clear	Nodular disease in intersegmental plane	"No difficulty"	Apical and posterior RUL	None	Anterior subsegment RUL	35	Necrotic blood clot; numerous air leaks
2	35, W, F	Clear	Well-defined	"Intersegmental veins denonstrated"	Apical RUL	Pleural approximation anterior segment to posterior segment	Anterior subsegment RUL	12	Intersegmental veins thrombosed; leaks discernible
3	15, W, F	Nodular, anomalous vessels	Fibrotic, ill-defined	"Sharp dissection"	Posterior RUL	None	Apical RUL	9	Numerous small BP fistulas
4	31, W, M	Anomalous blood vessels	Well-defined	No technical difficulty	Apical and posterior RUL	Pleural tent	Anterior subsegment RUL	16	Demonstrable surface air leaks
5	35, W, M	Clear	Clear	Clamping and ligation of veins in intersegmental plane	Apicoposterior LUL	None	Anterior subsegment LUL	10	Localized surface air leaks
6	23, W, M	Clear	Well-defined	"Ligation of 'distal' pulmonary veins of intersegmental plane"	Apicoposterior LUL	Thoracoplasty (modified)	Anterior subsegment LUL	16	No comment by surgeon
7	25, Japanese F	Clear	Well-defined	"Veins draining intersegmental plane ligated and cut"	Posterior RUL	Pleural tent	Apical subsegment RUL	13	Surface air leaks
8	25, Spanish F	Clear	Fibrotic	Clamping and ligation of veins in intersegmental plane	LUL equivalent	Pleural tent	Lingula	10	Numerous small BP fistulas
9	20, W, M	Nodular	Nodular disease in intersegmental plane	Wedging and ligation of "many" intersegmental veins	Apicoposterior LUL	Pleural tent	Anterior segment LUL	22	Air leaks; surgical hemorrhage; pulmonary artery
10	33, W, F	Nodular	Fibrotic, ill-defined	Wedging across intersegmental plane	Apicoposterior LUL	Pleural tent	Anterior subsegment LUL	10	No comment by surgeon
11	24, N, F	Nodular	Fibrotic	Sharp dissection required; difficult	Posterior LUL	Pleural approximation anterior segment to superior segment LUL	Apical LUL	10	Localized surface air leaks
12	30, W, F	Clear	Well-defined	"Clamping and ligation of intersegmental vessels"	Apical and posterior RUL	Thoracoplasty (modified)	Anterior segment RUL	14	Foul odor; visible sutures; hemorrhage from pulmonary artery
13	42, W, M	Clear	Considerable fibrosis at hilum	"Delusion of segmental plane accomplished but difficult to start"	Apicoposterior LUL	Pleural tent	Anterior segment LUL	29	Gangrenous; visible thrombosed vessels
14	17, W, F	Nodular	Fibrotic	"Excessive oversewing of intersegmental vessels"	Apicoposterior LUL	Pleural tent	Anterior subsegment LUL	41	Surface air leaks over infarcted area
15	32, W, M	Nodular	Opened cavity in intersegmental plane	"Wedge across intersegmental plane"	Apicoposterior LUL	Pleural tent, anterior segment to superior segment LUL-pleural edges	Anterior subsegment LUL	144	Many sutures in necrotic tissues; 3 air leaks (minute)

(*) Description of the adjacent remaining segment in which infarction subsequently occurred.
(*) Report on the condition of the affected intersegmental plane at the time of the initial surgery.
(*) Pertinent difficulties encountered in performance of initial segmental resection.
(*) Bronchopulmonary segments removed during the first thoracotomy.
(*) Concomitant space obliterating procedure performed at the time of initial segmental resection.
(*) Time interval between the initial segmental resection and reoperation for infarction.
(*) Appearance of the intersegmental surface at the time of operation.

In all cases, the essential features leading to reoperation for presumptive infarction of an adjacent segment or subsegment consisted of a persistent air space, usually apical or "subtentorial" (if pleural tent created), and overlying a triangular density with its broad base directed medially and often having a concave upper margin. This apical air space occasionally showed a fluid level; however, none were successfully collapsed by needle or catheter aspiration. Inordinate pain, persisting beyond the immediate postoperative period, was a noticeable feature in one third of the cases. A sharp tearing pain in the affected region was sometimes reported. These patients as compared with others seemed to bleed more profusely in the early postoperative period. Three had hemothoraces treated by lytic agents (streptokinase-streptodornase) prior to removal of intrapleural tubes after initial thoracotomy.

The time which elapsed between initial segmental resection and reoperation averaged 17.6 days in 14 cases. In half of the patients, the second thoracotomy was performed in 9 to 14 days. The longest interval of 144 days occurred in a patient whose initial postoperative course was considered essentially normal. After being released to the Medical Service, there developed a gradually enlarging apical subtentorial air space with the characteristic underlying triangular density. Upon reoperation, a tuberculous pleuropulmonary cavity was demonstrated; this being the only case in which an active tuberculous lesion was proved at secondary thoracotomy. The subsequent course has been uneventful.

In regard to the first operative procedures, pleural space obliterating procedures were performed in 10 cases of which 8 consisted of construction of a pleural tent and in 2 a modified thoracoplasty was performed.[26] In three cases, partial obliteration of the pulmonary space created after segmental removal was accomplished by pleural margin approximation employing nonsuture cotton ligatures in two, and interrupted sutures in one.[27] All patients except one received intrathoracic instillation of streptomycin and penicillin.

At reoperation, an apical or subtentorial air space was detected of varying dimensions having an average volume of 100 to 300 cc. The average space diameter was 5 to 6 cm. In all instances, air leaks could be demonstrated over various areas of the infarcted tissue. Upon stripping fibrinous material from the affected segment, the latter characteristically did not bleed but bubbled diffusely and presented a firm, woody, or soft, frankly necrotic texture to palpation. Its color varied from purplish-red to brownish-black depending upon the stage and the extent of the necrosis. In two cases, there was a frank odor of gangrenous tissue.

The extent of the infarction was variable. It always involved some portion of the intersegmental surface and characteristically involved the most distal portion of the specimen; sectioning revealed extension of varying distances into the underlying parenchyma. In three cases there was complete infarction of the entire related segment. When surgery was performed under three weeks, there was no great technical difficulty encountered in removing the infarcted segment or subsegment; however, there was an exception in one case as related below. A fairly clear line of demarcation was usually visible between necrotic and viable lung. Often peripherally the necrotic tissue could be wiped away with a gauze sponge or separated by blunt dissection. The main difficulty in the dissection was encountered at the hilum where, because of close proximity of the pulmonary vessels and the severity of the necrotizing process, serious hemorrhage may ensue, due in 1 of our cases to involvement of the wall of the pulmonary artery by the necrotic process. However, the outcome was entirely successful.

Follow-up studies for periods, ranging from three months to four years, have revealed no evidence of spread or reactivation in any, and no complications attributable to the second thoracotomy. Additional data pertaining to the 15 patients who had localized postresection infarction of the lung are listed in table 1.

PATHOLOGY

Grossly, the specimens were purplish black to brownish in color and had a variable consistency. Most presented a firm, indurated, noncrepitant texture but, in some cases, the material was markedly soft and friable. Thrombosis of surface veins buried in blood clot or fibrin along the intersegmental plane was frequently observed. The pleural surface of each specimen was often partially covered by a fibrinous layer having a variable consistency depending upon the time which had elapsed since the previous surgery. This layer was usually soft, friable, and yellowish white in color. The superficial surface of this plaque was often firmer than the underlying surface where it was in apposition with the necrotic tissue.

The cut surface of specimens usually revealed a dry, finely granular, purplish-black appearance which was sharply demarcated from any comparatively normal lung that may have been included with the specimen. In two specimens in which there was a distinct odor of gangrenous tissue, central softening and liquefaction were observed. Examination of the cut intersegmental surface often revealed thrombosed vascular structures leading into the necrotic lung.

Microscopic examination of sections taken at right angles to the segmental surface revealed characteristic hemorrhagic infarction with focal necrosis of pulmonary tissue tending to become confluent at the surface. The central portions of these lesions showed complete loss of cytologic detail including the nuclei of alveoloseptal cells. In spite of such profound necrosis, the tissue characteristically maintained its configuration with well-defined acidophilic hyaline walls inclosing degenerating masses of conglutinated red blood cells. Although occasionally the periphery of the infarcted area was well circumscribed by fibrous tissue (probably representing a sublobular fibrous tissue plane), it was more characteristic to find no such delimitation, the zone between viable and nonviable tissue being remarkably free of either fibroblastic tissue or inflammatory cells. Healing was evidenced by a feeble and ineffective organization of intra-alveolar fibrin resulting in thick-walled avascular nonfunctional alveoli.

The contained vessels showed thromboses and mural necrosis, particularly noticeable in the superficial intersegmental veins. Serial sections of the latter revealed proximal viability and luminal patency. Spaces within necrotic tissue were often observed; this was believed to be histologic representation of the multiple alveolopleural fistulas so characteristic of these lesions.

Three aspects of this material appeared particularly interesting to one of us (H. N. H.). Elastic stains upon necrotic tissue showed a surprisingly intact architecture despite the profound necrosis, and the prolonged interval following initial surgery. The necrotic tissue tended to become hyalinized and except for two cases there was little evidence of actual lysis of tissue. The second puzzling feature of these specimens consisted of a marked degree of endothelial proliferation and, often, luminal obliteration of related arterial structures. These were often observed in adjacent viable pulmonary tissue. The endothelial proliferation might be interpreted on the basis of adjacent tuberculous disease, however, the presence of an organizing thrombus would tend to discount this possibility. The final impressive feature was the degree to which metaplastic bronchial squamous epithelium was disrupted and dispersed among the peripheral layers of necrotic tissue.

BACTERIOLOGY

It is not surprising that infection did occur in 3 of the 15 cases. Such infections were confined to the infarcted segment, subsegment, or pleuropulmonary cavity. In two cases (12, 13; see table 1) there was frank gangrenous tissue, due presumably to a Vincent-type infection, although cultures were sterile. The final

case (15) was the only one showing evidence of an active tuberculous process in tissue removed at the second thoracotomy. The patient had a prolonged delay of 144 days before secondary thoracotomy and acid-fast bacilli were demonstrated on smear and tissue stains in the wall of the cavity; however, cultures were negative. In this instance, there was formation of a tuberculous pleuropulmonary cavity.

CASE REPORTS

Three clinical cases which illustrate this postresection syndrome of localized pulmonary infarction are presented below. The other 12 cases were rather uniformly similar to those here recorded; thus, an accurate preoperative diagnosis was made in our last 8 patients.

Case 2. A 35-year-old white woman was admitted on 9 April 1954, with a diagnosis of pulmonary tuberculosis. Numerous roentgenograms, since 1951, revealed a nodular infiltrate confined to the area of the right upper lobe which was considered to have undergone no change. However, in February 1954, two routine gastric cultures were positive for acid-fast bacilli. Other laboratory studies and physical examination revealed nothing remarkable other than post-tussic rales over the right upper chest. Chemotherapy consisted of streptomycin and isoniazid. On 22 October 1954, after 6 months of chemotherapy, a right upper lobe apical segmental resection was performed for significant residual nodular disease restricted to this segment. The created raw surfaces of the anterior and posterior segments were approximated at the pleural margin by four interrupted sutures. Twelve days after initial surgery, a thoracotomy was again performed because of a persistent air-fluid space which had not responded to multiple thoracenteses (fig. 1). The midpectoral subsegment of the anterior segment appeared to be infarcted, having a dense, rubbery consistency, and the vessels along the segmental plane were thrombosed; intermittently, air bubbled from this surface. The involved subsegment was removed without difficulty after which the raw segmental surfaces came into favorable apposition as the lung was expanded by the anesthesiologist; the pulmonary remnant filled the hemithoracic space completely. Two large tube pleural drains were connected to water-seal bottles and suction instituted. Subsequent recovery was uneventful and the patient has continued to do well (fig. 2).

Pathologic examination of the first specimen revealed caseonodose tuberculosis. The second specimen consisted of organizing hemorrhagic infarction of the anterior subsegment with nonspecific chronic pleuritis and pulmonary fibrosis.

Case 5. This 35-year-old white man was admitted on 18 April 1956, because of an expanding, rather circumscribed lesion in the left upper lobe (fig. 3). Skin tests: PPD No. 1, four plus; histoplasmin and

Figure 1. (case 2). Right lateral roentgenogram of chest showing postoperative air-fluid space at site of apical segmental resection. Triangular density anterior to space proved to be infarction of subsegment of the anterior segment.

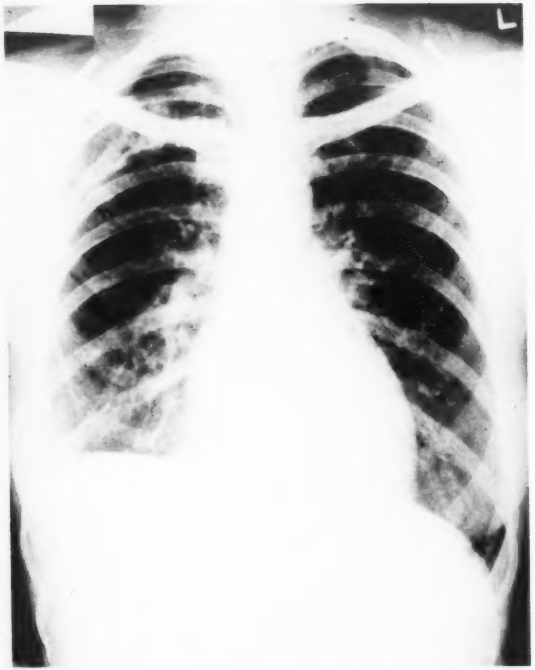

Figure 2. (case 2). Roentgenogram of chest 20 months later. Regenerated fifth rib on right. Patient asymptomatic.

segment of the anterior segment.

tomatic.

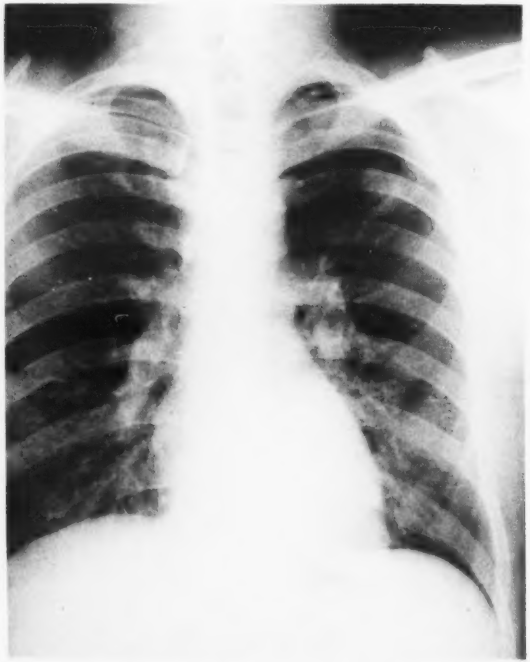

Figure 3. (case 5). Roentgenogram of chest prior to resection of solitary tuberculous lesion in apico-posterior segment.

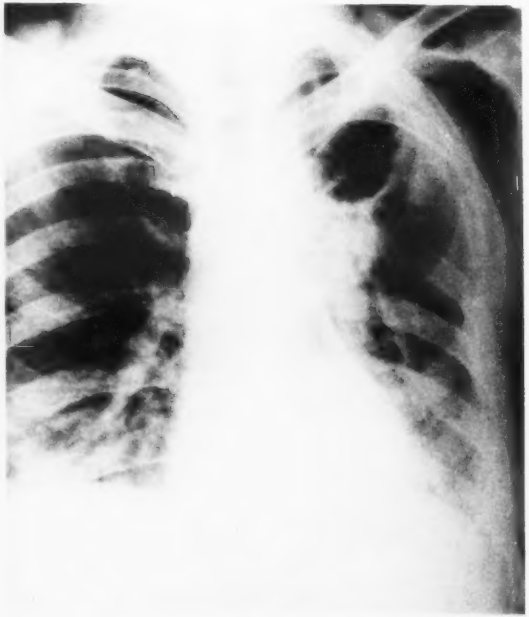

Figure 4. (case 4). Roentgenogram eight days after segmental resection. The large tension apical pleural space is demonstrated. Infarction in anterior segment produced the triangular dense shadow below the space.

Figure 6. (case 13). Roentgenogram of chest two and one-half months after second thoracotomy and concomitant upper stage modified thoracoplasty, left, in management of postresection infarction in the anterior segment.

Figure 5. (case 13). Roentgenogram taken 16 days after apicoposterior resection on the left where dense, roughly triangular shadow is demonstrated below apical space. Good contralateral expansion is noted four and one-half months after apical and posterior segmental resection and utilization of a pleural tent on right.

coccidioidin, negative. No positive smears or cultures for acid-fast bacilli were obtained. Streptomycin and isoniazid were started on 18 May 1956, and apicoposterior resection was performed 8 June. The solitary lesion, 2.2 cm in diameter, proved to be a rather thick-walled tuberculous cavity from which acid-fast bacilli were isolated. No concomitant collapse procedure was performed. In the postoperative period, the water-seal suction bottles continued to bubble and an apical air space failed to improve (fig. 4). He continued to complain of rather severe chest pain. Ten days after segmental resection, he was returned to surgery and an infarction of a subsegment of the anterior segment, from which air leaked freely, was demonstrated and removed. A modified thoracoplasty was performed and the patient has done well since.

Case 13. A 42-year-old white man noticed the onset of fatigue two years prior to admission. A chest roentgenogram on 31 July 1956, revealed bilateral upper lobe cavitation. The only early positive culture was obtained as the result of bronchial washings. Chemotherapy was instituted on 8 August 1956, with 600 mg of isoniazid and para-aminosalicylic acid, 12 grams daily. On 17 December the isoniazid was increased to 900 mg. On 15 March 1957, a right thoracotomy was performed with removal of the apical and posterior segments. A tent of the apical parietal pleura was performed and recovery was uneventful. On 28 March 1957, sputum culture was again positive for acid-fast bacilli and the isoniazid was increased to 1,500 mg with 1 gram of streptomycin daily. On 10 July 1957, an apicoposterior resection of the left upper lobe was performed. Postoperative x-ray studies revealed well-expanded lung with some cloudiness over the apex without discernible space. On 14 July the intercostal tubes were removed. However, on 26 July 1957 (fig. 5), an air space was observed at the apex and it was thought that this had resulted from an infarcted segment. Air leak was continuous, as demonstrated by needle aspiration. He complained of almost constant "sharp tearing" chest pain. Twenty-nine days following the initial left thoracotomy, the left thoracic cavity was entered through the previous operative site; pleural symphysis was observed over an extensive area, and incomplete infarction of the anterior segment was seen which had advanced to the stage of gangrene in one area. Small air leaks on the surface of this infarcted segment were observed and thrombosed vessels leading to the anterior segment were palpated and visualized. Segmental resection of the infarcted segment was accomplished and a modified thoracoplasty was performed. Subsequent course has been completely uncomplicated (fig. 6). The pathologic specimen consisted of the anterior segment showing a large area of infarction (fig. 7).

DISCUSSION

Pulmonary infarction complicating segmental resection, according to our concepts, is certainly not a new entity. The char-

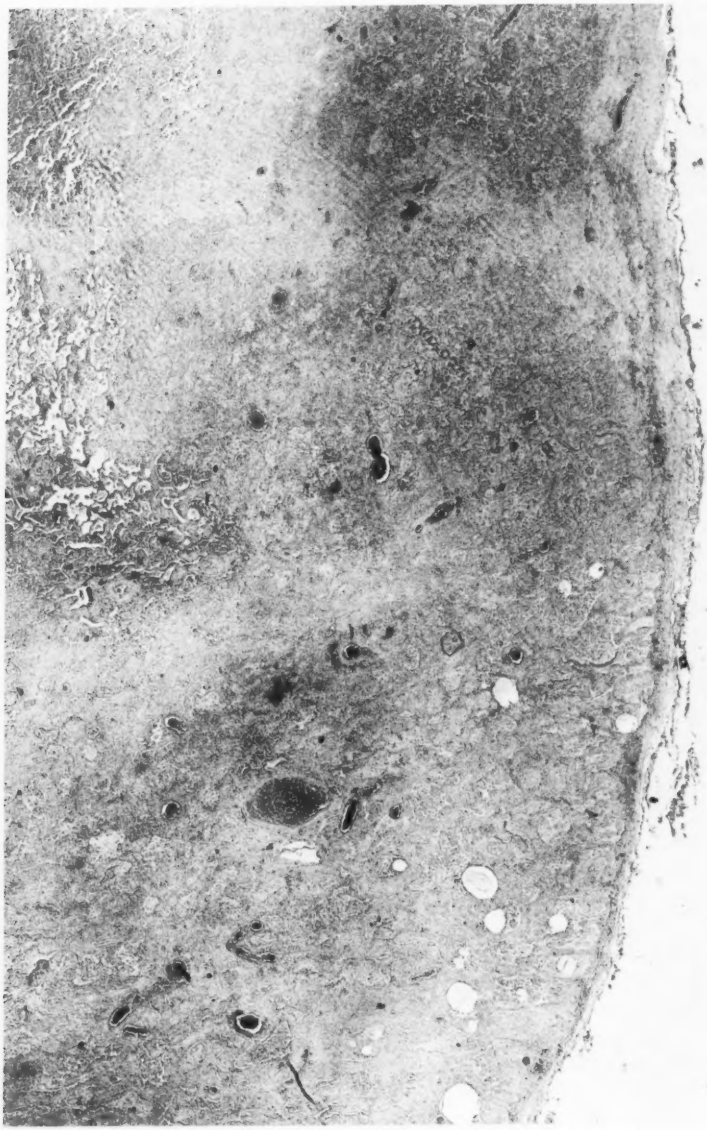

Figure 7. (case 13). Microscopic appearance of hemorrhagic pulmonary infarction, showing characteristic focal necrosis, air spaces, and vascular thromboses. Compressed alveoli and poor delineation left lower area.

acteristic symptomatology has long been recognized, but the underlying pathogenesis has not. Such terms as the "late space problem," "alveolo-pleural fistula,"[21] "masked broncho-pleural fistula,"[27] "occult broncho-pleural fistula"[21] have been offered in an effort to characterize this problem or its complications. The salient clinical findings and basic diagnostic features are: (1) a persistent tension air space in the region of the previous pulmonary resection, (2) no evidence of an overt bronchopleural fistula, and (3) commonly demonstrated roentgenographically, below the pleural space, is a triangular density with its broad base directed medially and having a concave upper margin if no fluid is present, otherwise, a horizontal air-fluid level.

The complications which may accompany or follow such pulmonary infarctions, if not corrected by early and proper surgical measures, are as follows: (1) A persistent and nonresolving air space, provided the resulting pulmonary infarction is of significant depth and magnitude. Such may negate the intended purpose of segmental resection, i. e., the preservation of uninvolved and apparently normal functioning pulmonary segments; thus, the space plus the fixed necrotizing and/or organizing segment will deter adjacent segments from expanding to full functional capacity. (2) Bacterial infections—blood, serum, avascular tissue, and the "dead space" provide an excellent culture media for bacterial growth; the intermittent ingress of respired air via the porous necrotic segmental surface is a factor worthy of mention. With due deference to antimicrobial agents, nevertheless, we must assume that, in due course of time, some untoward superimposed complication of a bacterial nature will ensue. A listing of such possibilities is proposed as follows: localized empyema, mixed empyema (pyogenic and tuberculous), tuberculous pseudopulmonary cavity, adjacent specific or nonspecific pneumonitis, contiguous tuberculous reactivation and/or distant spread, putrid lung abscess (such has been observed in our experience on one occasion, however, the exact nature of the pathogenesis was not determined), osteomyelitis of ribs, and chest wall infection. (3) Frank and indisputable bronchopleural fistula. (4) Massive fatal pulmonary hemorrhage—such has been reported in the literature following segmental and subsegmental resection.

The prevention of this type of postoperative complication, i. e., localized pulmonary infarction, depends to a large degree upon maintaining the integrity and continued patency of the remaining branches of the intersegmental vein. It is evident, when considering column 5 data in table 1 (Surgical difficulty), that the crux of the problem appears to be the surgically exposed surface venous channels, which, no doubt, play an important

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role during the immediate postoperative healing phase. It is noteworthy, that the surgeons reported various types and degrees of difficulties in 12 of the 15 patients during dissection in the intersegmental plane. Thus, many factors influence the postoperative competence of the intersegmental pulmonary veins. Some factors which immediately come to mind are: active or fibrotic tuberculous residuals involving the intersegmental plane; tuberculous nodules beyond the intersegmental boundary which are removed by additional wedge excision; excessive bleeding from intersegmental plane, requiring clamping, ligatures and sutures; excessive air leaks, the control of which may also require clamping, ligatures and sutures with possible inclusion of venous tributaries; rare anomalous venous distributions; and technical errors and difficulties. It might be noted that nine surgeons performed the initial surgery on the 15 patients developing this complication; two being staff surgeons and seven were residents on the thoracic surgery service—all being capable of operating independently or had staff surgeon assistance and supervision.

An additional factor which seems to warrant consideration is the possible prophylactic value of the surgically created pleural tent. We feel such a procedure may be of some value if the pulmonary surgical defect is relatively flat (not a deep "wedge-like" defect); thus, the pleural tent seems more commonly indicated after an upper lobectomy than following segmental resection. The prevention of this postoperative complication may depend also upon the degree of early angioplasia and venous channels which form in the fibrinous plaque separating the remaining segment from the adjacent pleural space. If there is rapid organization of this surface plaque, then minimally infarcted zones will probably be effectively walled off and healing will take place. On the other hand, if early angioplasia and fibroblastic proliferation is poor, the necrotic surface will continue to leak via multiple alveolopleural fistulas.

This early fibrinous plaque covering the raw surface is uniformly demonstrated in the experimental animal as well as in patients having had pulmonary resections and is a major contributing reparative process which makes the technic of segmental resection possible. This consideration should always be kept in mind by the surgeon who, in some instances, may elect to enhance this aspect of the surface healing process by performing a pleural tent or a limited modified upper-stage thoracoplasty. We have shown to our satisfaction on numerous occasions, after performing pulmonary dissection technics on dogs, that the rapidly forming fibrinous pleural plaques make it extremely difficult to produce alveolar air leaks of sufficient

duration to produce pleural air spaces, although we rather uniformly establish areas of subsegmental infarction by ligation of intersegmental veins.[28]

CONCLUSIONS AND RECOMMENDATIONS

It seems superfluous to state that surgical skill, judgment, and experience are all important, nevertheless we are convinced that any thoracic surgeon, regardless of experience and training, may from time to time be confronted with this postoperative complication. Therefore, it seems imperative that all should keep this syndrome in mind when postresection space problems occur. It is very questionable if it is proper to apply conservative methods of management such as multiple thoracenteses and re-insertion of catheters and tubes for lengthy periods. Most of our patients have been given the benefit of such methods of early management without any evidence of success. Accordingly, it is proposed that if such methods fail in four to six days that secondary thoracotomy is in order. Re-inserted closed drainage tubes should not remain long enough to initiate or contribute to secondary infection. It is our opinion that secondary thoracoplasty alone would be curative in only a small percentage of cases; however, such a procedure of the modified type or construction of an apical parietal pleural tent concomitantly with secondary thoracotomy will not infrequently be necessary.

At this juncture of our incomplete understanding of this problem of postsegmental infarction of the lung, we hesitate to make any concrete or dogmatic recommendations and proposals other than those related above. Nevertheless, a "scheme of surgical conduct" is offered which we believe is sound in principle as based upon our clinical experience and incompleted laboratory investigation of this problem to date.[28]

Recommended Scheme of Surgical Conduct

1. Maintain integrity of branches of intersegmental vein on surface of retained segment. Segmental surface clamping, ligatures, and stitch sutures are kept to a minimum; hemostasis is often surprisingly complete after complete expansion of the segment by the anesthesiologist; meticulous and gentle dissection in the intersegmental plane is mandatory.

2. Do not attempt suture infolding of raw segmental surface.

3. Do not attempt reconstitution of pulmonary remnant by multiple layer sutures beginning in the depth of the postresection defect; such closure technique would seem to contribute to intersegmental venous stasis, thrombosis, and subsequent infarction.

4. Complete removal of segment peripherally is essential; dissection may easily progress outside the intersegmental plane,

leaving a "nubbin" of subsegment quite devoid of circulation, although expansion may be surprisingly good.

5. Perform upper lobectomy on the right in favor of apical and and posterior segmental resections planned, i. e., if fibrosis and nodular disease are found to involve the apical and anterior intersegmental plane. Pleural tent or limited modified thoracoplasty may seem indicated.

6. A similar situation on the left, as related in 5 above, with apicoposterior resection contemplated—if intersegmental fibrosis not overly extensive—suggest that anterior segment be retained, and manage infarction of anterior segment by secondary thoracotomy if such should develop.

7. Secondary thoracotomy in 10 to 14 days when there is clinical and roentgenographic evidence of postoperative pulmonary infarction. Surgical judgment will dictate if concomitant pleural tent or modified thoracoplasty should be performed.

SUMMARY

A series of 15 patients, having incurred pulmonary subsegmental or segmental infarction following segmental resection for tuberculosis in 400 consecutive procedures, has been analyzed. Clinical and roentgenographic features characterizing this postoperative complication are presented. The proposed pathogenesis of demonstrated infarcted contiguous segments and pathologic findings are discussed, and recommendations are offered in regard to prevention. Once frank pulmonary infarction occurs, secondary thoracotomy in 10 to 14 days is recommended. All 15 patients having had secondary thoracotomy are without evidence of reactivation and doing well 3 months to 4 years after segmental resection. The mortality to date in this series of 400 pulmonary segmental resections is 0.5 per cent; 1 patient having died of cardiac arrest at completion of pulmonary resection and the other of pulmonary hemorrhage 6 weeks after upper lobectomy and superior segmental resection.

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BUTCHERED AND MAULED, BUT RUGGED

The English language is a marvelously supple tool, responsive to artisan as well as to artist, sometimes more expressive after having been inelegantly butchered, usually at its worst in the mouths of pedagogues and salesmen, and certainly a rugged system of symbol to withstand the maulings of all of us.—The Medical Spectator: On Disorders of Pen and Paper. *North Carolina Medical Journal,* July 1959.

Clinicopathologic Conference

Walter Reed Army Hospital

Summary of Clinical History. The patient was a 44-year-old master sergeant with 16 years of military service. As a child he had an attack of scarlet fever which left him partially deaf in one ear. At the age of 16 he had a urinary tract infection which kept him in bed for 6 weeks, and from which he recovered without residuals. Otherwise he had enjoyed good health until the onset of his present illness. Two years prior to the present admission, a moderately severe bilateral flank pain developed that radiated into the scrotum and was definitely accentuated in the recumbent position. The patient also experienced nausea, anorexia, and a 30-pound weight loss. A medical work-up at a Veterans Administration hospital revealed no demonstrable lesion. On discharge from the Veterans Hospital, the patient went to the Mayo Clinic. A mild hypertension and a left hydrocele were found. Excretory urogram, proctoscopic examination, and lumbar myelograms were interpreted as normal. The Mayo Clinic advised laparotomy and the patient reported to Chanute Air Force Base.

First Hospitalization. An exploratory operation was performed at Chanute Air Force Base on 1 April 1955. The surgeon described a retroperitoneal tumor mass which extended from the lower border of the pancreas to the bifurcation of the aorta, surrounding the great vessels. This mass was considered an inoperable malignancy and, other than a biopsy, no further surgical intervention was undertaken. Microscopic sections of the biopsy specimen, however, revealed only chronic inflammatory tissue. No abnormal bleeding was reported during or following this exploratory laparotomy. After an uneventful postoperative course the patient was transferred to this hospital on 9 May.

From the laboratory service, Walter Reed Army Hospital, Col. Roland S. Aronson, MC, USA, chief. Maj. Gen. Leonard D. Heaton, Surgeon General, United States Army, was commanding general of the hospital at the time of this conference.

Second Hospitalization. A left hydrocelectomy and a testicular biopsy were performed. No tumor was found. The postoperative course was complicated by bleeding into the scrotum with formation of a large hematoma. Hematologic studies revealed a prolonged bleeding time, but despite thorough investigations no definite cause of this bleeding tendency could be established.

It was again decided to explore the retroperitoneal space to establish a diagnosis. Laparotomy on 27 July revealed the previously described hard retroperitoneal mass which was found to engulf the middle third of the left ureter. Frozen and permanent sections of the biopsy material again revealed only chronic inflammation and fibrosis. Increasing evidence of ureteral obstruction necessitated a left nephrectomy and ureterectomy, which were performed on 18 August 1955. The ureter was removed to the point where it disappeared into the tumor mass. Examination of another biopsy specimen taken from the main tumor mass again revealed only chronic inflammation and fibrosis. Following an uneventful recovery, the patient was discharged to duty.

THIRD HOSPITALIZATION

After two symptom-free months, the patient noted recurrence of back and flank pain. He was treated with antibiotics for pyuria. The pyuria cleared, but the back pain remained. Excretory urography was suggestive of a right ureteral calculus, and the patient was readmitted on 6 June 1956 for evaluation and therapy.

Physical Examination. The patient's temperature was 98.6°F; blood pressure, 150/96 mm Hg; pulse rate, 72. He was slightly obese. No lymphadenopathy was present. Abdominal examination revealed no palpable organs or masses. Rectal examination findings and the prostate were normal. Neurologic examination findings were normal.

Laboratory Studies. Urinalysis was normal with a specific gravity of 1.004. The white blood cell count was 10,400 per μl, with a normal differential. Hemoglobin was 12 grams per 100 ml. Blood urea nitrogen was 30 mg per 100 ml. Bleeding time was 21 minutes. Total serum protein was 4.9 grams (albumin 2.0, globulin 2.9) per 100 ml. Repeated roentgenograms of the chest, gastrointestinal series, barium enema, and gallbladder series were normal.

Course in Hospital. After the bleeding time had returned to normal (on cortisone, 100 mg daily), a cystoscopic examination and a right retrograde urogram were performed. The ureter was dilated, but there was no evidence of calculus. The previous impression of calculus was ascribed to a kink in the ureter. This retrograde study did show obstructive uropathy in the middle third of the right ureter. A ureteral catheter was left in place. On 27 June,

the white blood cell count was 22,000 per μl with 90 per cent neutrophils.

On 28 June, right ureteral lysis and nephrostomy were performed. Numerous 1-mm yellow abscesses yielding a pure culture of *Staphylococcus pyogenes* var. *aureus* were noted on the surface of the kidney. Blood cultures were negative. Postoperatively the patient's temperature rose to 105°F, but by 7 July, on a regimen of oxytetracycline (Terramycin), penicillin, and streptomycin sulfate, he was afebrile. Urinary output was above 1,500 ml daily. On 1 July, the blood urea nitrogen was 58 mg per cent. The patient did well until 7 July, when the posterior aspect of the wound separated; it was closed under anesthesia. He again did fairly well and cortisone was progressively decreased until it was discontinued on 12 July.

On 13 July, the patient began to bleed from the right flank incision. A right nephrogram showed extravasated contrast material in the soft tissue about the nephrostomy (Malecot) tube, and faintly visualized grossly dilated calyces of the right kidney. Intravenous hydrocortisone and whole blood were given; the patient was taken to the operating room and, under general anesthesia, retroperitoneal packs were placed around the kidney in an effort to secure hemostasis. The bleeding was coming from the lower pole of the kidney where the nephrostomy tube had pulled through the renal parenchyma. Penicillin and streptomycin sulfate were reinstituted. Intravenous Premarin, vitamin K, and hydrocortisone were started. Over the next few days, the patient received several liters of whole blood. On 15 July, serum sodium was 111 mEq per liter; potassium, 5.5 mEq per liter; chlorides, 85 mEq per liter; carbon dioxide combining power, 22 mEq per liter; blood urea nitrogen, 66 mg per 100 ml; and hemoglobin, 13.6 grams per 100 ml. On 16 July, sodium was 132 mEq per liter; potassium, 7.0 mEq per liter; and chlorides, 81 mEq per liter. Urinary output continued at 2,000 ml per day.

Again the patient began to improve gradually. On 28 July the last of the retroperitoneal packs was removed. The patient improved to the point where oral fluids and a soft diet were tolerated. On 5 August, his blood pressure suddenly dropped to 60/40 mm Hg. A massive hemorrhage from the right flank wound had occurred. On 6 August, the patient was taken to the operating room where the wound was opened, and it was found that the bleeding was coming from the necrotic lower pole of the kidney. This was debrided and sutured with ribbon catgut, with apparent good result. In the recovery room, however, the patient again began to bleed and, despite whole blood, intravenous hydrocortisone, and levarterenol bitartrate injection, his condition deteriorated, and he died on 8 August.

DISCUSSION

Doctor Kimbrough:* The excretory urogram of 7 March 1955 (fig. 1) shows prompt appearance of the contrast medium bilaterally outlining normal calyces and pelves. The upper portion of both ureters is well visualized on all films. The lower half of the right ureter is deviated toward the midline. The midportion of both ureters is narrowed for a distance of 2 to 3 cm. The renal and psoas shadows are seen and appear to be normal. No soft tissue masses or bony abnormalities are noted. No abnormal calcification is seen. My impressions are (1) normal calyces and pelves bilaterally; (2) deviation of the lower half of the right ureter toward the midline; and (3) the upper half of both ureters seen on all films which would indicate, in retrospect, an obstruction of both ureters in their mid-portions. The excretory urogram of 2 August 1955 shows nonfunction of the left kidney. The right kidney and ureter show no change since 7 March 1955.

Figure 1. Essentially normal excretory urogram of 7 March 1955.

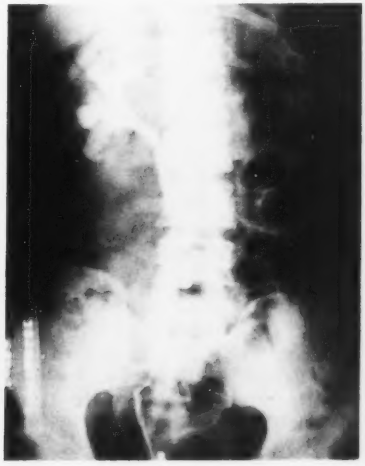

Figure 2. Right retrograde urogram of 25 June 1956, showing hydronephrosis and narrowing of the ureter.

The retrograde urogram of 5 August 1955 shows moderate caliectasis, pelviectasis, and ureterectasis of the upper half of the left ureter. The narrowing and partial obstruction in the midportion of the right ureter are more prominent than on the films of 7 March 1955.

The right retrograde urogram of 25 June 1956 (fig. 2) shows moderate caliectasis and pelviectasis. The upper half of this ureter is dilated. The mid-point of the ureter is partially obstructed. The lower half of the ureter is deviated toward the midline. The lower two ribs on the

*Capt. John G. Kimbrough, MC, USA, second-year resident in radiology.

left have been partially resected, and the left renal shadow is not seen. The right renal and psoas shadows are not clearly outlined. My impressions are (1) status postnephrectomy on the left; (2) partial obstruction of the mid-point of the right ureter; (3) hydronephrosis of the right collecting system above the mid-point of the right ureter; and (4) deviation of the lower half of the right ureter toward the midline.

Doctor Patton:* The chief complaint of our patient was moderately severe bilateral flank pain which radiated into the scrotum. Although not pathognomonic, this distribution of pain is at least suggestive of renal and upper ureteral disease. The sensory and sympathetic nerve fibers of the renal capsule, pelvis, and upper ureter center in the 10th, 11th, and 12th thoracic and first lumbar segments. Ureteral pain is closely related to renal pain. The upper ureteral nerves issue by way of the renal plexus from the same segments as those of the renal pelvis but are in more intimate relation to the nerve fibers that go to the testes. This patient also noted that the pain was definitely accentuated when he was in the recumbent position. This is not uncommon in hydronephrosis resulting from ureteral obstruction, as drainage may be impaired when the patient is in the recumbent position while the pain is relieved when he is in an upright position due to improved drainage by gravity.

Two exploratory laparotomies revealed a retroperitoneal mass surrounding the aorta and inferior vena cava, and obstructing the ureters. Repeated biopsies of this mass showed only chronic inflammatory tissue. The ureteral obstruction eventually necessitated removal of the left kidney and surgical drainage of the right kidney. The patient's course was greatly complicated by a prolonged bleeding time of obscure cause. The remaining right kidney eventually became severely infected and the patient died as a result of uncontrollable hemorrhage associated with the infection and a hemorrhagic diathesis.

In summary, we have a patient with bilateral ureteral obstruction due to a retroperitoneal mass with secondary hydronephrosis and progressive deterioration of renal function over a two-year period.

Assuming that the pathologic study of the biopsy material was correct, we can rule out malignant neoplastic disease. I believe that the case presented today falls into the category of nonspecific inflammatory disease involving the retroperitoneal area. Since the initial report by Ormond[1] in 1948, this clinical entity has appeared in the literature with increasing frequency.[2-16] At a meeting of the American Urological Association, Talbot and Mahoney[15] reported a collected series of 16 cases and added one of their own. Eleven of the patients in this group were male and six were female. The ages ranged from 23 to 64 years, with 11 (69 per cent) being between 30 and 45 years of age. Of the 14 patients who were followed, 3 died of renal insufficiency.

*Col. John F. Patton, MC, USA, chief, genitourinary service.

The other 11 are living and well after 3 to 10 years. The onset and development of this process is insidious. On admission, renal failure was present or imminent in all but two of the patients. The duration of symptoms ranged from 10 days to 2 years. One of these patients had undergone a laminectomy and one a hysterectomy as a consequence of the symptoms. Pain was usually dull and more often bilateral than unilateral. About 50 per cent of the patients in the series had either oliguria or anuria. Fatigue, anorexia, and weight loss were common. Review of the histories failed to demonstrate the cause of the condition. No significant antecedent illnesses or operations common to two or more of the patients were found, except appendectomy in three cases and mild hypertension which was present in 50 per cent of the patients. The history of previous genitourinary tract disease was uniformly negative.

Diagnosis depended on the recognition of the significance of the repeated pathologic finding of chronic inflammation and fibrosis of the retroperitoneal tissue. In this reported series, the operative findings consisted of a dense grayish-white sheath of fibrous tissue, measuring up to several centimeters in thickness and impinging on the aorta, iliac vessels, vena cava, and ureters. This fibrous mass often extended as high as the kidneys. Autopsies were performed on two of the three patients who died. The gross and microscopic findings were similar in both and were consistent with a chronic inflammatory process.

In the treatment of these patients two principles emerge: the relief of urinary obstruction and the preservation of renal tissue. Each case must be studied individually and the indications for surgical intervention carefully weighed.

The patient under discussion today had a typical course in comparison with those in the reported series. In the differential diagnosis there are two other inflammatory conditions which might be mentioned. The first is primary ureteritis. Noring[19] of Denmark reported a case of primary ureteritis of undetermined cause and surveyed the literature of acute and chronic regional ureteritis causing obstructive symptoms. In these cases, however, the disease was confined to one side and involved only the ureter, not the periureteral or retroperitoneal tissues. The second entity to be considered is what Vest and Barelare[20] chose to call chronic periureteritis plastica in their report of four cases. Again, this process was fairly sharply limited to the periureteral tissues and widespread retroperitoneal involvement was absent. Although these two entities do not appear to be similar to our patient's difficulty, there may possibly be some relationship in the pathogenesis. One common factor may be abortive infections, which have gone unrecognized and healed spontaneously, with productive fibrosis. A second factor may be the anastomoses between lymphatics of the bladder and lower urinary tract and those of the adventitia of the ureters. These connections have been well demonstrated by Winsbury-White[21] who

injected dye particles at the base of the bladder and cervix in female patients and traced the dye particles in the adventia of the ureters all the way to the kidneys. It also is possible that injudicious use of antibiotics may contribute to this type of chronic, low-grade infection.

In summary, I believe that this interesting case falls into the category of chronic nonspecific retroperitoneal fibrosis of undetermined cause. The bleeding tendency of this patient was apparently unrelated to the basic disease process, although it hopelessly complicated the management of the case and contributed to the fatal outcome.

Dr. Patton's diagnosis:

Chronic nonspecific retroperitoneal fibrosis (Ormond's disease) of undetermined cause

PATHOLOGIC FINDINGS

Doctor Dart:* At autopsy, the significant findings were limited to the peritoneal cavity and retroperitoneum. The abdominal viscera were matted together by innumerable fibrous adhesions. A terminal peptic ulcer of the posterior wall of the duodenum had perforated and communicated by a fistulous tract with the right flank wound. There was extensive hemorrhage and induration throughout the retroperitoneum. A large sheet of dense fibrous scar tissue encased the aorta and the inferior vena cava. The circumference of the aorta was regular. The intimal lining of both the aorta and vena cava was smooth. These vessels were patent. The zone of tumefaction extended from the inferior border of the pancreas to the pelvic brim and averaged 1 cm in thickness posterior to the aorta. Fibrosis extended laterally over the vertebral bodies and psoas muscles. The left kidney was surgically absent. The right perinephric space was occupied by a large amount of fresh clotted blood. The weight of the right kidney was increased to 375 grams as a result of the massive hemorrhage. The organ was largely destroyed and only the upper pole showed recognizable cortex and medulla. The renal vessels were regular. The right ureter followed the usual anatomic course from renal pelvis to urinary bladder and was of normal size. At a point 6 cm below the renal pelvis, the ureter was involved by a fibrous nodular extension of the main mass of retroperitoneal fibrous tissue described above. The lumen of the ureter was patent although slightly narrowed at this point. There was extensive hemorrhage within the urinary bladder.

Microscopic sections revealed the retroperitoneal mass to be composed of dense collagenous inflammatory scar tissue (fig. 3) which had enveloped nerves, ganglia, and lymphoid tissue and had replaced the adventitia of the vessels. There was fibrosis of the wall of the aorta and focal disruption of the elastica. A characteristic feature was the presence of an angiitis involving veins, from small ones to

*Capt. Leroy H. Dart, MC, USA, third-year resident in pathology.

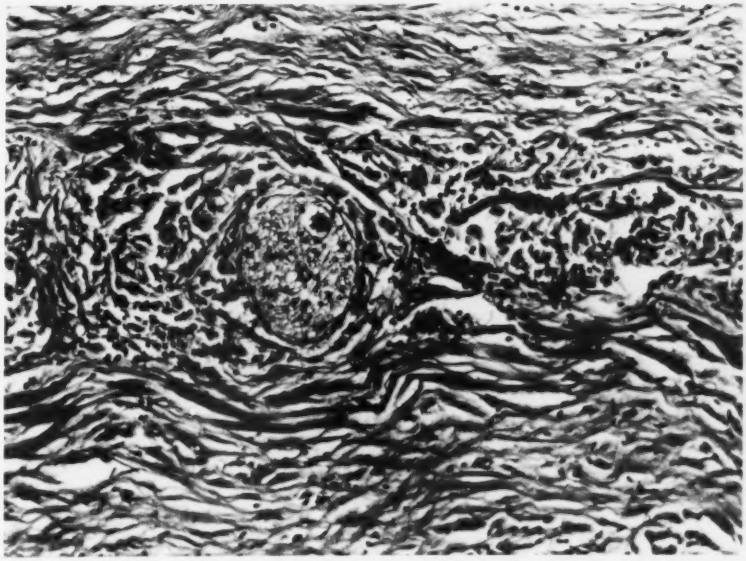

Figure 3. Photomicrograph of section from scar tissue posterior to aorta, showing dense collagenous connective tissue engulfing nerves. (× 165)

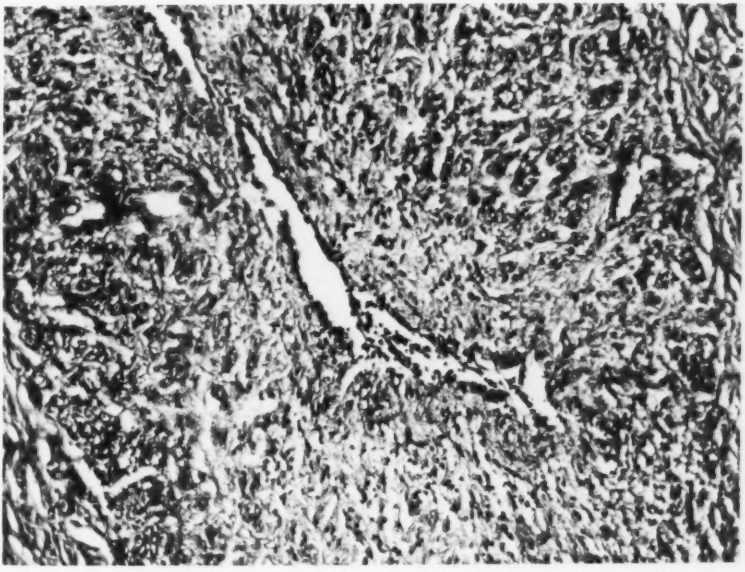

Figure 4. Photomicrograph of section from wall of inferior vena cava, showing obliterating phlebitis of small venous channels. (× 165)

the inferior vena cava. This process had led to the obliteration of a number of venous channels (fig. 4). The phlebitis was limited to the retroperitoneal mass. Phlebitis had been noted in previous biopsies, but it was not present in any of the other organs examined. The right ureter, in the region of partial obstruction, was surrounded by a sheath of collagenous scar tissue. The right kidney was the seat of extensive hemorrhage, necrosis, and acute inflammation with abscess formation. Examination of the remainder of the tissues was noncontributory.

We believe there exists a causal relationship between the chronic fibrosing retroperitonitis and the phlebitis. The phlebitis was bound to cause stasis and an increase in protein-rich tissue fluid. The altered tissue environment favored the laying down of dense collagen, which in turn produced more stasis. The basic cause of death was an idiopathic chronic fibrosing retroperitonitis (Ormond's disease), complicated by infection and hemorrhagic diathesis of undetermined cause. The immediate cause of death was exsanguinating hemorrhage.

Pathologic diagnoses:

1. Idiopathic chronic fibrosing retroperitonitis (Ormond's disease), complicated by infection and hemorrhagic diathesis of undetermined cause
2. Exsanguinating hemorrhage

COMMENTS

Doctor Sprinz:* Dr. Patton's discussion highlights the dichotomy of actual clinical experience and the presentation of the same case at a clinicopathologic conference. While alive on our wards, the patient posed a very difficult problem in diagnosis and management. As an illustration, it might be mentioned that the roentgenograms shown by Dr. Kimbrough represent a small selection from over 150 taken. We arrived at the diagnosis only after prolonged study of the autopsy material. Just as has been the experience elsewhere, we did not initially appreciate the significance of our own histopathologic examinations and believed that the multiple biopsies had yielded only the inflammatory reactive outer edge of a neoplastic process. In retrospect, it is clear that the onset of the first clinical symptoms was already a late manifestation of the patient's disease. Considerable time, possibly years, is needed to lay down such an amount of hyalinized inflammatory scar tissue as was demonstrated in the patient.

Dr. Dart has demonstrated the pertinent anatomic findings. The next question is, "How did this process evolve?" I consider it unlikely that it is the result of an extension of an inflammatory process in this man's genitourinary tract or intestines. In such an event, the main mass of inflammatory scar tissue should be right in the vicinity of the organ primarily infected, as is the case in sclerosing periureteritis

*Lt. Col. Helmuth Sprinz, MC, USA, chief of pathology section.

and perinephritis, or in pelvic retroperitonitis following lymphogranuloma inguinale of the rectum, or as a rare complication of dysentery.

In our patient, the main tumefaction had occurred in the midline surrounding the great vessels and affecting the ureters only secondarily, and sparing the mesentery and the pelvic extraperitoneal tissues. The paranephric space bound by the anterior and posterior renal fascia is separated into a left and right compartment which makes it unlikely that a unilateral kidney disease could have triggered the process from which the patient was suffering. We are left, then, with the assumption of a primary disease of the retroperitoneum, possibly resulting from a segmental phlebitis or angiitis in this area. This could account for the remarkable feature of Ormond's disease that even over prolonged periods of observation it remains confined to the retroperitoneal space and does not extend into the mesentery nor into the mediastinum where an independent but similar process, sclerosing mediastinitis, may occur. Regional vascular disease is not unknown, for example, Buerger's disease, pulseless disease, segmental arteritis. So far, Ormond's disease has always been considered a primary urologic entity. Possibly this is incorrect and we are dealing with a vascular disease of a specific region.

Unfortunately, search of the literature has yielded only inconclusive results. The majority of papers on Ormond's disease have been written by clinically oriented authors with the main purpose of calling attention to the entity. Only a few autopsy studies exist, and these are hard to evaluate. None describes the phlebitis which is prominent in our patient. As is so frequently the case, diagnosis of a disease precedes comprehension of the pathologic process involved. It is hoped that future observation will elucidate the pathogenesis of Ormond's disease.

Doctor Aronson: I think this has been a particularly interesting discussion as it has concerned a type of case which involves many specialties—medicine, urology, orthopedics, radiology, pathology. I don't know whether it was brought out, but one of these patients was treated for a malignancy by x-ray therapy, despite a tissue diagnosis of only chronic inflammation, without expected benefits. Internists have treated such cases as chronic nephritis in the nephrotic stage. They have been treated for multiple myeloma. Others, as this one, have had exploratory laparotomies and been diagnosed as inoperable malignancies. It has been brought out that orthopedists see these cases as backaches, and neurosurgeons have taken out disks in looking for the answer to this condition. We should all keep in mind this rare but important clinical entity.

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CLARITY IN WRITING

Any written communication, be it letter, memo, or article, that is not written well enough to be understood by its intended recipient indicates a lack of consideration, arrogance, and inefficiency on the part of its author. No matter how brilliant the thought or the discovery, if it cannot be communicated in writing it may become lost.—Should the School Teach Its Students How To Write? (Editorial): *Harvard Public Health Alumni Bulletin*, June 1959.

Peritoneal Dialysis in Liver Coma

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WILBUR C. BERRY, *Colonel, MC, USA*

ELEVATION of the level of ammonia in the blood is thought to be related to the clinical syndrome known as liver coma. Knowledge of this has led to continued efforts to discover an effective means to lower the blood ammonia in certain disease states. Present approach to therapy in such cases has taken three general forms: (1) Measures to decrease the formation of ammonia in the bowel lumen, (2) use of chemical agents to speed its excretion from the body through metabolic pathways, and (3) hemodialysis to rid the blood of excess ammonia.

Inasmuch as the breakdown product of free blood by bacterial action in the bowel lumen is a relatively enormous source of ammonia, general measures have included esophageal tamponade, gastric lavage, catharsis, and high colonic irrigations to stop the bleeding or rid the bowel of undigested blood. Neomycin or other appropriate antibiotic agents that destroy ammonia-forming bacteria normally present in the gut is also used. To facilitate the excretion of ammonia from the blood through metabolic pathways, sodium glutamate, arginine, and similar agents have been used by some workers with temporary success.[1-7]

More recently, Kiley and associates[8] used hemodialysis with the artificial kidney in the treatment of five patients who were comatose with ammonia intoxication. Their results show that ammonia can be effectively removed by this method. Unfortunately, at present the artificial kidney and the trained personnel necessary for its operation are not universally available. Also, as pointed out by the above-mentioned authors, use of the artificial kidney poses the theoretic disadvantage that the blood of a patient already bleeding be rendered uncoagulable.

In 1956 one of us (W. C. B.) used peritoneal dialysis on two patients in liver coma with apparent salutary effect. Both patients returned to normal conscious levels and were improved for several days. Blood ammonia levels were not performed on these patients, however.

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We have recently carried out peritoneal dialysis in a patient moribund from liver coma in order to determine its effect on the course of the disease and to see if the measured blood ammonia could be lowered by this method.

CASE REPORT

A 60-year-old comatose man was admitted to this hospital on 7 November 1958. He had been admitted to another hospital on 5 November, at which time he was in shock from massive bleeding from the gastrointestinal tract. A two-year history of known cirrhosis of the was elicited from the patient's wife. He had felt relatively well on the morning of 5 November but later in the day vomited considerable blood, went into shock, and was admitted to the hospital where he remained in coma in spite of successful treatment of bleeding and shock by esophageal tamponade, transfusion of whole blood, and supportive treatment. Venous blood ammonia was reported as 91 micrograms per 100 ml on 5 November.

Physical examination on 7 November revealed an elderly, jaundiced, comatose man. His temperature was 101°F; pulse rate, 100 per minute; blood pressure, 120/58 mm Hg; respirations, 30 per minute, deep, and with fruity odor to the breath. Several ecchymotic spots were present over both arms, the head, and the thorax. Numerous spider nevi were present on the upper trunk and shoulders. The liver was palpable 5 cm below the right costal margin. There was a trace of pretibial pitting edema. The facial musculature on the right was flaccid and hyperreflexia of the right half of the body was noted.

The admission white blood cell count was 4,100 per μl with a normal differential. The hemoglobin was 12.0 grams per 100 ml and the hematocrit was 35 ml per 100 ml. The latter values rose to normal levels following whole blood transfusion and remained within normal limits thereafter. Urinalysis revealed a specific gravity of 1.026, an acid reaction, and a trace of albumin and sugar. Bile was present in the urine and there were one to three white blood cells per high-power field. Repeated determinations of serum electrolytes, including sodium, potassium, chlorides, calcium, and magnesium were within normal limits. The carbon dioxide combining power averaged 30 mEq per liter on 8 and 9 November. Total serum protein was 6.1 grams (albumin 2.4 grams, globulin 3.7 grams) per 100 ml. The serum bilirubin on 9 November was 11 mg per 100 ml and rose to 13.4 mg per 100 ml on 10 November. The blood urea nitrogen values ranged from 23 to 39 mg per 100 ml. Spinal fluid examination findings were normal. The prothrombin time was 40 per cent of control values. The serum acetone on repeated testing was negative. Cultures of peritoneal dialysate fluid showed no growth. Serial electrocardiograms showed some depression of S-T segment in many leads, a prolongation of the Q-T interval, and in some instances a small U wave. Values for venous blood ammonia levels and level of ammonia in dialysate fluid recovered are expressed in figure 1.

Figure 1. Values for venous blood ammonia levels and level of ammonia in dialysate fluid recovered.

On 8 November peritoneal lavage was carried out because there had been no improvement in the patient's comatose state for the preceding 72 hours. The procedure and the solutions used were as previously reported by Hearn and Berry.[9] For each dialysis 1,000 ml each of a standard stock solution of normal saline, 5 per cent dextrose in distilled water, and 5 per cent dextrose in saline were used and modified as follows: to each of these solutions (left in its original container) was added 45 mEq of sodium bicarbonate, 4 mEq of potassium chloride, and 100,000 units of aqueous crystalline penicillin. Ten ml of 10 per cent calcium gluconate was given intravenously after each of the two dialyses to correct for calcium loss into the dialysate fluid. The first dialysis was completed at 1800 hours and the second at 2100 hours on 8 November. Near the termination of the second dialysis, the patient's condition changed dramatically from a state of deep coma to the point where he opened his eyes, raised his head, moved his extremities, and spoke coherently. Dialysis was not carried out on 9 November because he remained fairly lucid. Later in the day, however, he lapsed into partial coma once more. On 10 November he remained partially comatose, but moved his extremities on command and responded to painful stimuli.

The third dialysis was carried out during the afternoon of 10 November, and the fourth during that evening. During the night, the patient once more improved, answered simple questions, moved all extremities, and attempted simple calculations with partial success. Around 0100 on 11 November he again lapsed into progressive coma and expired at 0700 hours.

Significant gross autopsy findings included a pale-tan, finely nodular liver which on microscopic section showed evidence of portal cirrhosis, an enlarged spleen, esophageal varices and erosion of the esophageal mucosa 2 m from the esophagogastric junction. Except for mild hyperemia of the serosal surface of the small intestine, there were no unusual changes in the peritoneal cavity in the immediate vicinity of the indwelling polyethylene tube.

COMMENT

There are three clinical situations in which ammonia intoxication is apt to occur: (1) In far-advanced liver disease without apparent precipitating influence, such as hemorrhage into the gastrointestinal tract, excess intake of protein or medication such as ammonium chloride; (2) in liver disease associated with one of the latter precipitating factors; (3) in cases of massive gastrointestinal hemorrhage associated with severe liver disease. As pointed out by Kiley and associates,[8] dialysis probably is not indicated in the first two instances cited above, because in the patient with far-advanced disease, there are too many associated metabolic abnormalities, and in the second instance merely withholding protein or offending medication from the diet might reverse the process. The most commonly met clinical example of the third instance is the cirrhotic patient with massive bleeding from the gastrointestinal tract.

Such a person literally poisons himself with his own blood, because, as previously pointed out free blood in the lumen of the intestine is a potential source of ammonia. His diseased liver is unable to cope with the increased load of ammonia carried to it by the portal vein, and the level of the blood rises. If conventional measures fail to control the level of ammonia in the blood, the indication for hemodialysis probably exists.

Interpretation of the results of hemodialysis in patients studied thus far has been difficult. A number of investigators[3,6,10,11] point out that recovery from clinical symptoms often lags behind the time of maximal lowering of blood ammonia values and cannot be correlated precisely with the degree of consciousness. Najarian, Harper, and McCorkle[7] suggested that this delay may be related to the fact that there also is an apparent lag in the change in the concentration of the cerebrospinal fluid ammonia level as compared to the level in the blood, and that level of consciousness is more nearly related to the former than to the latter. Exactly how ammonia is related to the degree of consciousness is not precisely known. This problem has been discussed recently by a number of authors.[12-14]

Our clinical impression in this case was that there was a direct relation between the falling level of ammonia in the blood and the return to near normal level of consciousness in our patient incident to the application of peritoneal dialysis. It appears to us that peritoneal dialysis is an effective method for the removal of ammonia from the blood. It may prove to be a useful procedure in those instances in which the indication for hemodialysis exists and the artificial kidney is not available or is contraindicated.

SUMMARY

A patient, moribund from liver coma, was treated by repeated peritoneal dialysis. The blood level of ammonia was effectively lowered by this method. Coincident to this, the patient improved clinically. Because of its apparent effectiveness, simplicity, lack of complications, and universal availability, peritoneal dialysis probably warrants further trial in selected cases of liver coma.

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FOOD IS THE WAY YOU FEEL ABOUT IT

People usually avoid eating those foods they have been conditioned to dislike. Sometimes the mere mention of, the sight of, or even the thought of such foods is likely to cause a distressing emotional reaction. Perhaps the most important group of foods to which people develop aversions are the taboo foods which may be prohibited by national, regional, familial, individual, religious, economic or political beliefs, and by folk superstitions. For example, our moral and ethical codes forbid the eating of human flesh, although accounts indicate that it is both tasty and nutritious. By extension, the taboo against cannabilism causes us to avoid eating the flesh of household pets, such as cats and dogs, which are considered by many as members of the family. We avoid eating foods which we believe come from filthy sources. Sometimes, the mere thought of having eaten such a food will make us sick. One of my patients on a visit to Mexico enjoyed certain crisp tidbits called gusanitos del maguey. Some days later she became violently ill after learning that the delicious morsels were fried, salted caterpillar grubs.—William Kaufman: Some Emotional Uses of Foods, *Connecticut Medicine*, March 1959.

NAVY AND AIR FORCE ANNOUNCE NEW DEPUTY SURGEONS GENERAL; COOPER, McILNAY RETIRE

Rear Admiral Edward C. Kenney, MC, USN, and Brigadier General John K. Cullen, USAF (MC), have been appointed deputy surgeons general of their respective military departments in a series of top level retirements and reassignments in the Navy and Air Force.

Admiral Kenney, who has been assistant chief for personnel and professional operations since March 1958, became deputy and assistant chief of the Bureau of Medicine and Surgery on 19 June 1959, succeeding Rear Admiral Bruce E. Bradley, MC, USN. Admiral Bradley,

Admiral Kenney

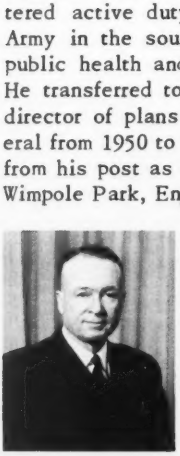
General Cullen

who has served as deputy surgeon general for the past four years, has relieved Rear Admiral Thomas F. Cooper, MC, USN, as commanding officer of the National Naval Medical Center, Bethesda, Maryland. Admiral Cooper was retired on 25 June in the rank of vice admiral.

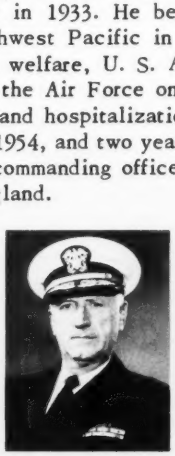
General Cullen became deputy surgeon general on 1 August, succeeding Major General Olin F. McIlnay, who retired 31 July. General Cullen has served as director of plans and hospitalization in the office of the surgeon general for the past two years, and will be replaced by Colonel Raymond T. Jenkins, USAF (MC), his deputy since 1958.

Born in Corning, Ohio, Admiral Kenney was graduated from the University of Cincinnati Medical College in 1929, and entered the U. S. Navy as a lieutenant (j.g.) in June of the same year. During World War II he was awarded the Navy Cross for "extraordinary heroism" while serving as senior medical officer of the U.S.S. *Boise* in the Battle of Cape Esperance, Guadalcanal, October 1942. Later, he received the Bronze Star Medal with Combat "V" for service as staff medical officer for Amphibious Group Three, Pacific Fleet, participating in landings on Guam, Leyte, and Lingayen Gulf. In 1955, he became commanding officer of the U. S. Naval Hospital, Bethesda, Maryland, where he served until 1958, when he was assigned to the Bureau of Medicine and Surgery.

General Cullen, a native of Pittsburgh, Pennsylvania, was graduated from the University of Pittsburgh School of Medicine in 1932, and entered active duty in 1933. He became deputy surgeon of the Eighth Army in the southwest Pacific in 1945, and a year later, director of public health and welfare, U. S. Army Military Government, in Korea. He transferred to the Air Force on 1 July 1949, and served as deputy director of plans and hospitalization in the office of the surgeon general from 1950 to 1954, and two years later was recalled to this position from his post as commanding officer of the U. S. Air Force Hospital at Wimpole Park, England.

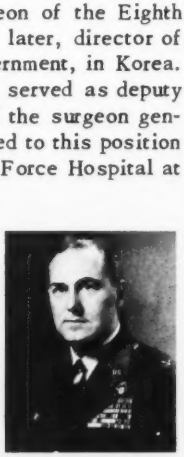


Adm. Bradley



Adm. Cooper

Gen. McIlnay



Col. Jenkins

Admiral Bradley, a 1926 graduate of the University of Virginia School of Medicine, received the Legion of Merit for service as senior medical officer of an advanced naval base on Bougainville Island, Solomon Islands, for seventeen months in 1943 and 1944. From October 1949 to June 1951, he served as executive officer of the U. S. Naval Hospital, Bethesda. A tour of duty as commanding officer of the U. S. Naval Hospital, Key West, Florida, preceded an assignment in June 1953, as commanding officer of the U. S. Naval Hospital, Oakland, California. In 1955, he became deputy and assistant chief, Bureau of Medicine and Surgery.

Colonel Jenkins was graduated from Duke University Medical School in 1935. He entered military service in 1939, and served in the Southwest Pacific Theater during World War II. During the Korean conflict,

he commanded the 13th Medical Group, one of the few medical organizations to be awarded the Distinguished Unit Citation. Prior to his assignment as deputy director of plans and hospitalization in 1958, he was surgeon of the Twelfth Air Force. He will be succeeded as deputy director by Colonel Herbert H. Kerr, USAF (MC).

Admiral Cooper, who retired after more than 35 years' active service, entered the Navy in 1924, the year he was graduated from Jefferson Medical College. During the first year of World War II, he was senior medical officer of the U.S.S. *Atlanta,* which was sunk by the Japanese in November 1942. He was awarded the Bronze Star Medal with Combat "V" for heroic action as a medical officer during this action. In 1950, he assumed command of the U. S. Naval Hospital, Great Lakes, Illinois, and two years later became medical officer of the First Naval District, Boston. In July 1953, he became assistant chief of the Bureau of Medicine and Surgery for Planning and Logistics, serving until October 1955, when he was assigned as inspector general of Medical Department activities.

Major General McIlnay, a 1928 graduate of the State University of Iowa School of Medicine, retired after more than 30 years active military service. He entered the Army Medical Corps reserve as a first lieutenant the same year and, on completion of his internship, received a regular commission. During World War II he was assigned as staff surgeon for the Eighth Fighter Command and the Second Air Division in England. Returning to the United States in 1945, he was named assistant surgeon of the Army Air Forces Training Command, and two years later became command surgeon. General McIlnay served as director of plans and hospitalization, office of the surgeon general, from 1952 to 1957, when he became deputy surgeon general.

TENTH ANNUAL MILITARY MEDICO-DENTAL SYMPOSIUM

The Tenth Annual Military Medico-Dental Symposium will be held on 28-30 October, at the U. S. Naval Hospital, Philadelphia. Captain Robert F. Norris, MC, USNR, professor of clinical pathology and Director of the Pepper Laboratory of Clinical Medicine, University of Pennsylvania, is permanent chairman of the meeting.

Major General Leonard D. Heaton, MC, USA, surgeon general of the Army, and Rear Admiral Richard A. Kern, MC, USNR (Ret.), professor of medicine, Temple University, will participate in the day and evening sessions, which are centered around the theme of environmental medicine, including polar, altitude, and submarine aspects. More than 30 other civilian and military personnel are scheduled to appear on the program.

AIR FORCE OFFICERS NAMED KEY CHAIRMEN FOR 1959 MEETING OF MILITARY SURGEONS

Two Air Force Medical Service officers assigned recently to important new duties have been named the key chairmen of the sixty-sixth annual meeting of the Association of Military Surgeons by Brigadier General Harold H. Twitchell, USAF (MC), surgeon of U. S. Air Force in Europe, president of the society. The meeting will be held at the Mayflower Hotel, Washington, D. C., November 9, 10 and 11, 1959.

Colonel Aubrey L. Jennings, USAF (MC), surgeon of Headquarters Command, U. S. Air Force since 1954 and commander of the new hospital at Andrews Air Force Base, will be general chairman of the meeting. He was recently named chief professional consultant to the Air Force Surgeon General. Colonel Frank M. Townsend, USAF (MC), the new director of the Armed Forces Institute of Pathology, is chairman of the scientific program committee. Formerly deputy director, he succeeded Captain William M. Silliphant, MC, USN, on 1 August, and is the first Air Force officer to hold this position. Captain Silliphant will retire on 1 September after more than 29 years of naval service.

Colonel Jennings

Colonel Townsend

General Twitchell has designated "Practice of Military Medicine—Broadening Concepts" as the theme for the 1959 meeting, and has announced the organization of the following committees:

GENERAL CHAIRMAN

Aubrey L. Jennings
Colonel, USAF (MC)

ASSISTANTS TO GENERAL CHAIRMAN

Archie A. Hoffman
Colonel, USAF (MC)

Frank J. Schaffer, M. D.

SCIENTIFIC PROGRAM COMMITTEE

Frank M. Townsend—*Chairman*
Colonel, USAF (MC)

Frank H. Van Wagoner
Colonel, MC, USA

Romulus L. May
Captain, MC, USN

Carruth J. Wagner, M. D.

Reber Miller Van Matre, M. D.

SCIENTIFIC EXHIBITS COMMITTEE

Herman Van Cott—*Chairman*

L. Paul Flory

Joe M. Blumberg
Colonel, MC, USA

Robert V. Schultz
Captain, MC, USN

James J. Culhane

Frederick S. Spiegel
Lt. Colonel, USAF (MC)

COMMERCIAL EXHIBITS COMMITTEE

Steven K. Herlitz—*Chairman*

REGISTRATION AND RECEPTION COMMITTEE

Dorothy N. Zeller—*Chairman*
Lt. Colonel, USAF (NC)

Paula Crowe
Major, USAF (NC)

Carrie E. Barrett
Lt. Colonel, NC, USA

Margaret Meagher

Burdette Blaska
Commander, NC, USN

DINNERS AND LUNCHEONS COMMITTEE

Audrey A. Underkofler—*Chairman*
Colonel, USAF (MSpC)

Florence S. Linduff

Milton W. Skolaut

Helen R. Cahill

Harriett S. Lee
Lt. Colonel, AMSC, USA

CEREMONIES AND ENTERTAINMENT COMMITTEE

Paul Goodwin—*Chairman*
Colonel, USAF (MC)

John B. Collins
Captain, MSC, USA

E. Lynne Christy
Major, USAF (NC)

William K. Douglas
Lt. Colonel, USAF (MC)

William J. Clegg
Lt. Colonel, MSC, USA

Edith Jones

INTERNATIONAL COMMITTEE

George B. Green—*Chairman*
Colonel, USAF (MC)

Mary C. Grimes
Commander, NC, USN

Fernando S. Rojo
Lt. Colonel, MSC, USA

Arthur R. Turner, M. D.

RESERVE OFFICERS AFFAIRS COMMITTEE

Donald J. O'Brien—*Chairman*
Captain, MC, USN

Paul Goodwin
Colonel, USAF (MC)

James H. Kidder
Colonel, MC, USA

William L. Ross, Jr., M. D.

PUBLICITY COMMITTEE

Raymond L. Towne—*Chairman*
Lt. Colonel, USAF

Basil W. Dano
Major, MSC, USA

Irving Goldberg

Mae Mills Link, Ph. D.

Rita Nelson

William T. Parker

Ralph D. Ross
Captain, MC, USN

Adabelle Smith

PROFESSIONAL ACTIVITIES COMMITTEE

David Gold—*Chairman*
Colonel, USAF (MC)

Robert H. Barter, M. D.

Herbert W. Coone
Colonel, USAF (MC)

William C. Hernquist
Lt. Colonel, USAF (MC)

John M. Keshishian, M. D.

Frank H. Van Wagoner
Colonel, MC, USA

TRANSPORTATION COMMITTEE

Dane M. Smith—*Chairman*
Major, TC, USA

RESOLUTIONS COMMITTEE

Frank E. Wilson—*Chairman*
Brigadier General, MC, USAR

Leroy E. Burney, M. D.

James A. McCallam
Brigadier General, USA (Ret.)

NOMINATING COMMITTEE

Leigh C. Fairbank—*Chairman*
Brigadier General, USA (Ret.)

SUSTAINING MEMBERSHIP COMMITTEE

L. Eugene Daily, M. D.—*Chairman*

H. D. Beck

Lex M. Cowsert

Robert L. Lefevre

Leonard A. Scheele, M. D.

John R. Wood
Brigadier General, USA (Ret.)

LETTERMAN HOSPITAL COMMANDER PROMOTED

Brigadier General Achilles L. Tynes, commanding general of Letterman Army Hospital, San Francisco, since November 1958, recently received the silver stars of his new rank in a ceremony at Letterman. He formerly was commanding officer of the U. S. Army Hospital, Fort Dix, New Jersey.

A native of Virginia, General Tynes was graduated from the University of Virginia Medical School in 1930, and was commissioned in the Army Medical Corps the same year. After completing postgraduate studies at Mayo Clinic in 1939, he was assigned to Walter Reed Army Hospital. In 1941, he became an assistant in hospital construction planning for the Army surgeon general, where he assisted in the planning and construction of the hospital program for World War II. He also supervised planning for construction and modification of the fleet of 29 hospital ships—an achievement for which he received the Legion of Merit.

General Tynes

General Tynes assumed command of Tripler Army Hospital in 1945, and supervised construction of the present hospital. He returned to the surgeon general's office in 1947 as chief of the medical facilities and planning branch and, in 1949, became head of the medical plans and operations division. From 1951 to 1955, General Tynes commanded the U. S. Army Hospital, Fort Knox, Kentucky, whence he was assigned to the Far East Command.

MEDICAL SYMPOSIA AT SANDIA BASE

Three medical symposia have been scheduled at the Field Command, Armed Forces Special Weapons Project, Sandia Base, New Mexico, during fiscal year 1960. Top secret security clearance is required on all candidates approved for attendance. Dates of the symposia are: 14-18 September 1959 (MWMS-6); 16-20 November 1959 (MWMS-7); and 14-18 March 1960 (MWMS-8). Medical officers on active duty and inactive reserve medical officers are eligible to attend.

CAPT. MARSHALL, NAVY VETERAN, RETIRES

Captain Leslie B. Marshall, MC, USN (Ret.), who was appointed editor of the United States Navy *Medical News Letter* on 4 August 1950 and held the position longer than his six predecessors combined, reverted to retired status on 30 June after completing more than 42 years of naval service. For the past year he also has been chief of the publications division in the Bureau of Medicine and Surgery.

Captain Marshall

A medical veteran of both world wars, Captain Marshall was graduated from the University of Tennessee College of Medicine in 1917. He served aboard the U.S.S. *Nevada* and *Nokomis* during World War I, and later on the U.S.S. *Relief, Black Hawk* and *Houston.* In 1939 and 1940 he was in Peiping, China, with the U. S. Marine Corps, and in September 1941 was sent to London as a special naval observer prior to the United States' entry into the war. During and following the war he commanded large Navy hospitals in Norman, Oklahoma, Houston and Camp Wallace, Texas, Parris Island and Beaufort, South Carolina, and on Guam. His colorful career also included assignments as medical officer of the Seventh and Fifteenth Naval Districts, in Jacksonville, Florida, and Balboa, Canal Zone.

Captain Marshall was transferred to the retired list on 1 July 1953, but remained on active duty, as editor of the *Medical News Letter.* His successor in the Bureau of Medicine and Surgery is Captain Donald R. Childs, MC, USN, formerly on the medical staff of U. S. Naval Hospital, Philadelphia.

SYMPOSIUM IN AVIATION CARDIOLOGY

An "International Symposium on Cardiology in Aviation," co-sponsored by Aerospace Medical Association, Airline Medical Directors Association, and the U. S. Air Force School of Aviation Medicine, will be held 12-13 November 1959 at Brooks Air Force Base, Texas. Those desiring to attend should write Dr. Lawrence E. Lamb, chief, Department of Internal Medicine, U. S. Air Force School of Aviation Medicine, Brooks Air Force Base, Texas.

COLONEL MAXWELL NAMED ARMY MSC CHIEF

Colonel Roy D. Maxwell, MSC, USA, assistant for nuclear warfare instruction and casualty studies at the Army Medical Service School, Brooke Army Medical Center, Fort Sam Houston, Texas, since January 1957, became chief of the Army Medical Service Corps on 1 July 1959. He succeeds Colonel Bernard Aabel, MSC, USA, who has been assigned to the Army Medical Information and Intelligence Agency, Arlington, Virginia.

Colonel Maxwell

An authority on nuclear radiation and radiation fall-out, Colonel Maxwell served as radiological safety officer in the atomic bomb tests at Bikini in 1946, and has attended many nuclear and thermonuclear tests in the Pacific area and at the New Mexico proving grounds, where he was chief of the fall-out group in the Armed Forces Special Weapons Project at Sandia Base, New Mexico. He also has served as chief of the department of biophysics at the Army Medical Service Graduate School, Washington, D. C., and director of the physiology and pharmacology division at the School.

A native of Oklahoma City, Oklahoma, Colonel Maxwell was graduated from Oklahoma City University in 1930, and received M. S. and Ph. D. degrees in organic chemistry from the State University of Iowa in 1931 and 1933, respectively. He entered the United States Army Reserve as a second lieutenant 4 November 1935, and was commissioned as a major in the Regular Army, Pharmacy Corps, 29 July 1946. On 4 April 1947, he transferred to the Medical Service Corps. He graduated from the Command and General Staff School in 1945.

AEROSPACE MEDICAL COURSE PLANNED

An advanced course in aerospace medicine for senior medical officers of allied nations will be held in September 1959 at the U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas, as part of the Air Force support of the military assistance program.

ARMY SG NAMES VOEGTLY EXECUTIVE OFFICER

Colonel Voegtly

Colonel John H. Voegtly, MC, USA, executive officer at Walter Reed Army Hospital since 1956, was appointed recently to a similar position as executive officer to the Army surgeon general. He relieves Colonel Bryan C. T. Fenton, MC, USA, who has been assigned as commanding officer of Martin Army Hospital, Fort Benning, Georgia.

A 1937 graduate of the University of Pittsburgh School of Medicine, Colonel Voegtly began his Army career in 1938, after an internship at Walter Reed Army Hospital. During World War II, he served as planning officer in the office of the chief surgeon, European Theater of Operations. He was assigned to the office of the Army surgeon general from 1945 to 1948 and, following a three-year residency in internal medicine at Walter Reed Army Hospital, was assigned in 1951 as plans and operations officer in the medical section of the Seventh Army in Germany. Prior to his assignment as executive officer at Walter Reed, Colonel Voegtly was chief of the Department of Atomic Casualties Studies at Walter Reed Army Medical Center for a year. He was graduated from the Army War College in 1955. His decorations include the Legion of Merit.

OFFICIAL DECORATIONS

The following awards were announced recently by the Departments of the Army and Air Force.

Legion of Merit

Drayton L. Trumbull, Col., USAF (DC)

Army Commendation Ribbon with Metal Pendant

Santino J. Lerro, Col., MC, USA

Arthur F. Strandberg, Capt., MC, USAR

Air Force Commendation Medal

Alan L. Buchsbaum, Capt., USAF (MSC)

Clyde C. Currier, Col., USAF (MSC)

Archie A. Hoffman, Col., USAF (MC)

Donald E. Summers, Capt., USAF (MSC)

DEATHS

DURHAM, Wilson Ervin, Captain, AFRes (MC), of Muskogee, Oklahoma; assigned to 809th Medical Group, MacDill Air Force Base, Florida; graduated in 1957 from University of Oklahoma School of Medicine, Oklahoma City, Okla.; appointed a first lieutenant in the United States Air Force Reserve on 15 June 1957; reported for active duty 9 August 1958; died 14 May 1959, aged 26, at Tampa, Fla., of a gunshot wound.

GAUNT, Robert Lancaster, Major, MSC, USAR, of Nashville, Tennessee; assigned to Army Medical Service School, Brooke Army Medical Center, Fort Sam Houston, Texas; served in enlisted status 18 January 1941 to 18 January 1946; graduated in 1949 from YMCA Night Law School, Nashville, Tenn.; appointed a captain in the Army of the United States 25 April 1949; reported for active duty 24 April 1956; died 17 June 1959, aged 42, San Antonio, Texas, of myocardial infarction.

KNIGHT, Leon Arthur, Lieutenant Colonel, USAF (MC), of North Hollywood, California; last assigned to 1071st Medical Service Sq., Fort Myer, Virginia, with duty station at Reed College, Portland, Oregon; graduated in 1944 from College of Medical Evangalists, Loma Linda-Los Angeles, Calif.; appointed a captain in the United States Air Force Reserve on 13 October 1952; reported for active duty 29 December 1952; commissioned a major in the United States Air Force 15 March 1955; retired for physical disability on 16 February 1959; died 5 May 1959, aged 43, at Veterans Administration Hospital, Los Angeles, of adenocarcinoma.

FIRST ARMED FORCES ORTHOPEDIC SEMINAR

Three distinguished orthopedic surgeons, Dr. Harold A. Sofield of Oak Park, Illinois, Dr. Joseph S. Barr of Boston, and Dr. Frank E. Stinchfield of New York City, will be guest speakers at the Navy-sponsored, first annual Armed Forces Orthopedic Seminar 23-25 September at the U. S. Naval Hospital, Oakland, California. Dr. Don O'Donaghue, Oklahoma City, will present a symposium and discussion on knee injuries. Orthopedic surgeons and residents on active duty and members of the northern chapter of the Western Orthopedic Association are invited to attend.

MAJOR BERRY IS ADVISOR FOR NEW TV PROGRAM

Major Charles A. Berry, USAF (MC), under orders to report in September to the office of the Air Force Surgeon General as chief of the aircrew effectiveness branch of the new division of aviation medicine, is now in Hollywood, California, serving as technical advisor for a new dramatic television program entitled "Space." The new program will star actor Bill Lundigan as the lead character, an Air Force officer, and is scheduled to begin on CBS-TV in September. Major Berry has been chief of the department of flight medicine at the U. S. Air Force School of Aviation Medicine, Randolph Air Force Base, Texas, for the past three years.

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Officers Certified by Specialty Boards

The surgeons general of the military medical services have announced that the following regular Medical and Dental Corps officers have been certified by the boards indicated.

American Board of Neurological Surgery

Silvernail, William I., Jr., Capt., USAF
Turpin, William R., Maj., USAF

American Board of Obstetrics and Gynecology

Austin, James A., Maj., USA
Becker, Merrill M., Maj., USA
Perrine, James P., Lt. Col., USA
Sams, James E., Lt. Col., USA
Staples, Pelham P., Jr., Maj., USAF
Van Pelt, James Y., Jr., Lt. Col., USAF
Westfall, Charles H. P., Maj., USA

American Board of Ophthalmology

Clark, Randall L., Capt., USAF
Heyner, Conrad S., Capt., USAF

American Board of Oral Surgery

Ketcham, Frank H., Lt. Col., USAF

American Board of Pathology

Chamblin, Stuart A., Jr., Capt., USA

Pathologic Anatomy

Hartley, Lawrence J., Capt., USAF

American Board of Periodontology

Ambrose, James A., Maj., USAF
Detamore, Robert J., Maj., USAF
Samaha, Francis J., Maj., USAF

American Board of Preventive Medicine

Public Health

Buscemi, Michael D., Col., USA
Daniels, Roswell G., Lt. Col., USA
Markowitz, Isidor, Lt. Col., USA
Patton, Maurice G., Capt., USA
Wilson, William J., Lt. Col., USA

Aviation Medicine

Bratt, Harry R., Maj., USAF
Claro, Joseph J., Maj., USAF
Haworth, Wallace G., Capt., USAF
Holstrom, Fritz M. G., Maj., USAF

American Board of Radiology

Garfinkel, Burton, Capt., USA

American Board of Surgery

Dominy, Dale E., Capt., USA
Teagle, Ernest H., Capt., USAF

Thoracic Surgery

Jesseman, Winston, C., Lt. Col., USA

Progress Notes

Captain **Robert J. T. Joy**, MC, USA, a 1954 graduate of the Yale University School of Medicine, was awarded the Hoff Medal during graduation ceremonies for the Sixth Military Medicine and Allied Sciences Course at Walter Reed Army Institute of Research, in June. The medal is given annually to the student with the highest class proficiency. . . . .The second edition of *Management of Oral Disease*, by Colonel **Joseph L. Bernier**, DC, USA, was recently published by C. V. Mosby Company, St. Louis. The author is chief of oral and dental pathology, Armed Forces Institute of Pathology, and a 1932 graduate of the University of Illinois College of Dentistry.

Rear Admiral **Alfred R. Harris**, DC, USN, retired 1 June after more than 35 years of active service. Entering military service in 1917 as an Army flying cadet, he was commissioned a lieutenant (j.g.) in the U. S. Navy Dental Corps in 1924, after receiving his dental degree from the University of Nebraska. Prior to his retirement, Admiral Harris was district dental officer, Ninth Naval District. . . . .Captain **Edwin O. Seiser**, DC, USN, also retired 1 June, leaving the Navy after more than 21 years of active duty. He was senior dental officer at the U. S. Naval Auxiliary Air Station, Kingsville, Texas. . . . .Colonel **Robert H. Blount**, USAF (MC), deputy commander of the USAF School of Aviation Medicine, Randolph Air Force Base, Texas, supervised the presentation of a research exhibit at the "static" display shown by the U. S. Armed Forces during the 23rd International Air Show at LeBourget Airport, Paris, France.

Captain **Edmund E. Jeansonne**, Captains **Donald E. Cooksey**, **Louis S. Hansen**, and **Robert A. Middleton**, and Commander **Gilbert H. Larson, II**, DC, USN, all from the U. S. Naval Dental School, Bethesda, participated recently in the 76th annual meeting of the Maryland State Dental Association in Baltimore. . . . .Colonel **John A. Booth**, USAF (MC), recently assumed command of the 6045th USAF Hospital, Osan, Korea, succeeding Colonel **James K. Gray**, USAF (MC), who was reassigned to Stewart Air Force Base, New York. Colonel Booth was formerly Fourteenth Air Force surgeon, Robins Air Force Base, Georgia. . . . .Commander **Donald M. Honeywell**, MSC, USN, has been named as executive officer of the Hospital Corps School, U. S. Naval Hospital, Great Lakes, Illinois, succeeding Commander **Joseph W. Collins**, MSC, USN, who retired 1 July after 40 years of active service. Commander Honeywell was attached to the U. S. Naval Hospital, Bremerton, Washington, prior to this assignment.

Captain **James A. English**, DC, USN, head of the medicine and dentistry branch, Office of Naval Research, spoke on "The Dental Research Program—Review and Projection," at the 15th meeting of the committee on naval medical research, Division of Medical Sciences, National Academy of Sciences—National Research Council, in

Washington, D. C., on 5 June. . . . .Colonel **William A. Hamrick**, MSC, USA, was reassigned in June from the Army Medical Service School, Fort Sam Houston, Texas, to become executive officer for Major General **James P. Cooney**, surgeon, U. S. Army, Europe. . . . .Captain **John W. Albrittain**, MC, USN, reported recently as head of the Medical Corps Training Section, Training Branch, Bureau of Medicine and Surgery. He was formerly at the U. S. Naval Hospital, Bethesda.

Rear Admiral **James R. Fulton**, MC, USN, district medical officer, Fourth Naval District, Philadelphia, retired 15 June after 34 years active service. . . . .The following Navy Medical Corps officers were placed on the retired list as of 1 July: Captains **Benjamin Ahl**, Naval Air Facility, Monterey, California; **O. Henry Alexander**, Naval Shipyard, Charleston, South Carolina; **William C. Baty, Jr.**, Headquarters, U. S. Marine Corps, Washington; **Carr E. Bental**, Naval Dispensary, San Francisco; **William L. Berkley**, Naval Hospital, Camp Lejeune, North Carolina; **Ralph E. Fielding**, Thirteenth Naval District, Seattle; **Jack R. George**, Naval Training Center, San Diego; **John N. C. Gordon**, U. S. Naval Academy, Annapolis, Maryland; **John H. L. Heintzelman**, Physical Evaluation Board, Potomac River Naval Command; **Leroy L. Kenney**, Naval Hospital, Charleston, South Carolina; **Herman M. Mavetty**, Naval Amphibious Base, Coronado, California; **Lester E. McDonald**, Naval Aviation Medical Center, Pensacola, Florida; **Robert S. Simpson**, Naval Station, Tongue Point, Oregon; **Paul E. Spangler**, Physical Evaluation Board, Twelfth Naval District, San Francisco; **Guy E. Stahr**, Secretary, Naval Review Board, Washington; **William P. Stephens**, Naval Hospital, Annapolis; **Charles B. Stringfellow**, Physical Evaluation Board, Fifth Naval District, Norfolk, Virginia; **John R. Weisser**, Naval Ammunition Depot, Hawthorne, Nevada; **Otto W. Wickstrom**, Naval Hospital, Memphis, Tennessee; **Milton R. Wirthlin**, Eleventh Naval District, San Diego; **Oscar D. Yarbrough**, Naval Hospital, Bethesda; **Carl K. Youngkin**, Fourteenth Naval District, Pearl Harbor, Honolulu; and **Thomas J. Carter**, Camp Pendleton, California.

Modern Medical Monographs is offering a prize of $500 in a competition for unpublished manuscripts on clinical subjects in the field of internal medicine by physicians under 40 years of age. Authors of top-ranking manuscripts suitable for publication will be offered contracts for publication in book form. Manuscripts must be submitted by registered mail before 1 October 1959, to **Richard H. Orr**, M. D., 33 East 68th Street, New York 21, N. Y. . . . .Captain **George C. Burkley**, MC, USN, succeeded Captain **Ralph K. Hoch**, MC, USN, as commanding officer, U. S. Naval Dispensary, Washington, D. C., on 22 June. Captain Hoch has been appointed as a permanent medical member of the Navy Physical Evaluation Board, Potomac River Naval Command, Washington, D. C.

The U. S. Air Force Medical Service exhibit, "Space Medicine Research," was awarded a certificate of merit as the best exhibit in the section on military medicine at the American Medical Association's

1959 meeting. This is the second consecutive year that an Air Force medical exhibit has won this award. . . . .Before reporting to his new duty station as commanding officer of the Dental Detachment, Marine Corps Recruit Depot, Parris Island, South Carolina, Captain **William M. Fowler**, DC, USN, presented two table clinics before the American Dental Society of Europe in Stockholm, Sweden, 8 and 9 July. . . . . Dr. **Oglesby Paul**, clinical associate professor of medicine at the University of Illinois, has been appointed as consultant in internal medicine to the medical staff at the U. S. Naval Hospital, Great Lakes, Illinois.

Colonel **Carl G. Giesecke**, MC, USA, is the new commanding officer of the Medical Training Center, Brooke Army Medical Center, Texas, succeeding Colonel **Edward Sigerfoos**, MC, USA, who will become surgeon of the Eighth U. S. Army in Korea. Colonel Giesecke has been deputy surgeon of the Fourth U. S. Army for the past year. . . . .The American Society of Anesthesiologists recently appointed Commander **Thomas C. Deas**, MC, USN, chairman of its committee on defense and military affairs. He is the chief of the anesthesiology service, U. S. Naval Hospital, Philadelphia. . . . .Colonel **Joseph T. Caples**, MC, USA, has been named commanding officer of the U. S. Army Hospital and post surgeon at Fort Leavenworth, Kansas. He replaces Colonel **Joseph P. Russell**, MC, USA, who has retired after more than 27 years of active service.

Captain **Arthur R. Frechette**, DC, USN, has relieved Captain **Bernard H. Faubion**, DC, USN, as deputy chief of the dental division, Bureau of Medicine and Surgery. Captain Faubion assumes duties as fleet and force dental officer, Commander in Chief, Pacific Fleet. Captain Frechette was succeeded as head of the professional branch of the dental division by Captain **William R. Stanmeyer**, DC, USN. . . . . Colonel **John W. Raulston**, MC, USA, is the new commanding officer, 24th Evacuation Hospital, 67th Medical Group. He succeeds Lieutenant Colonel **Lloyd R. Stropes**, MC, USA, who has been assigned to Fourth Army Headquarters, Fort Sam Houston, Texas. . . . .Commander **Mary C. Grimes**, NC, USN, recently reported as head of the Nurse Corps Reserve Liaison Branch, Nursing Division, Bureau of Medicine and Surgery. She was formerly chief of nursing service at the U. S. Naval Hospital, Annapolis, Maryland.

Colonel **Conn L. Milburn, Jr.**, MC, USA, surgeon of the Military District of Washington for the past year, has recently been appointed executive officer of Walter Reed Army Hospital. . . . .Lieutenant Commander **Forbes H. Smith**, MSC, USN, has assumed his new duties as head of the internal review section in the fiscal systems branch, Comptroller Division, Bureau of Medicine and Surgery. He was formerly attached to the School of Hospital Administration, National Naval Medical Center.

A Message From the A. M. A.

This month's message concerns the seventh National Medical Civil Defense Conference in Atlantic City on 6 June 1959. The Conference is sponsored annually by the Council on National Defense of the American Medical Association and was presented this year by the United States Army Medical Service.

In welcoming the 297 participants from 41 states, the District of Columbia, Hawaii, and Canada, Louis M. Orr, M. D., then A. M. A. president-elect, told the audience that, ". . .as members of the health and medical professions, we individually and collectively have a tremendous role and responsibility in civil defense affairs."

Physicians and allied medical personnel attending the meeting received a summary one-day version of the Army's one-week education and training program dealing with mass casualty concepts and treatment technics. For a number of years, these courses have been conducted at the Army Medical Service School, Brooke Army Medical Center, Fort Sam Houston, Texas, and at Walter Reed Army Institute of Research, Walter Reed Army Medical Center, Washington, D. C. The general methods of instruction for these courses, already attended by 6,000 students, both military personnel and civilians, include lectures, student participation through practical exercises, group and panel discussions, visual aids, and demonstrations with manikins. The course embraces both short- and long-term expected injuries. Counter medical and health measures are stressed to combat the nuclear effects of blast, burn, and radiation injury, both from the preventive and curative standpoint.

Major General Leonard D. Heaton, The Surgeon General, United States Army, in introducing the Army Medical Service program, recalled his own experience at Pearl Harbor when "we were suddenly faced with many hundreds of casualties on that fateful Sunday morning." General Heaton pointed out that the management of multiple casualties requires, first of all, a plan based on experience and knowledge.

The speakers and their subjects were: Major Jack C. Fitzpatrick, MC, USA, "Casualty Estimation and Analysis;" Lt. Colonel Vincent I. Hack, MSC, USA, who presented a casualty demonstration; Lt. Colonel Joseph D. Goldstein, MC, USA, "First Aid—Survival Care;" Colonel Theodore M. Carow, MC, USA, "The Emergency Medical Packet for 100 Casualties;" Lt. Colonel

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From the Council on National Defense of the American Medical Association. The views and opinions expressed are not necessarily those of the Department of Defense. —*Editor*

H. Haskell Ziperman, MC, USA, "Sorting and Establishment of Priorities;" Lt. Colonel Edward H. Vogel, MC, USA, "Management of Burns Resulting from Nuclear Disaster;" Lt. Colonel William H. Moncrief, Jr., MC, USA, "Management of Soft Tissue Trauma;" Colonel Philip R. Beckjord, MC, USA, "Public Health Aspects of Preventive Medicine in Disaster;" Colonel William D. Tigertt, MC, USA, "Chemical and Biological Warfare;" Colonel Roy D. Maxwell, MSC, USA, "Impact of Radioactive Fallout on Medical Operations;" and Colonel Albert J. Glass, MC, USA, "Psychological Aspects of Disaster."

Members of the Army Medical Service, aware of the implications of nuclear warfare and cognizant of other serious threats from newer weapons, have made significant advances in many fields of emergency medical service. Using the experience of past wars, the results of research in the proper management of traumatic wounds, and the special clinical observations of patients in Army hospitals, there have evolved some fresh surgical approaches to old complex problems. With the development of larger weapons and greater casualty-producing devices and agents, there have been significant, though perhaps less dramatic, medical advances that appear to hold promise of reducing death and disability on the battlefield. Old ideas have been enlarged to newer wider concepts of action. For example, first aid is not merely what is done until the medical officer or medical corpsman arrives, but now includes the immediate application of these lifesaving and sustaining measures that each soldier must do for himself, or for his buddy, until medical aid arrives. Sorting is not the casual screening of patients by the admitting officer of the hospital, but an operative policy accepted by all medical officers at all times in the handling of casualties during mass casualty care operations. New dimensions in the treatment of burns, shock, hemorrhage, and traumatic injuries will make possible the saving of more lives and limbs with fewer medically trained personnel than was formerly believed possible. With adequate training and management, medical and other troops will be able to face biological, chemical and radiological attack, including radioactive fallout, with equal fortitude with which they have encountered other hazards in the past. Emotional and psychologic aspects of disaster, even when seen in large numbers of persons, should not be considered as hopeless problems, but they should be realistically handled as they are amenable to well-defined patterns of action.

The American Medical Association and its Council on National Defense are most appreciative for the provocative, stimulating, and informative program which was prepared and presented by the United States Army Medical Service.

Book Reviews

NAVY SURGEON, an Autobiography, by Rear Admiral *Lamont Pugh*, MC, USN, (Ret.), 459 pages; illustrated. J. B. Lippincott Company, Philadelphia, Pa., 1959. Price $5.

Of the 26 naval medical officers who have held the office of Chief of the Bureau of Medicine and Surgery in the Navy Department, only two have been the subjects of book-length biographies. The first was Jonathan Foltz who was with Farragut at the capture of New Orleans and was Surgeon General in 1871 and 1872. His life was written by a descendant and printed in 1931. Dr. Pugh's book is the first autobiography by any of this group of men, nearly all of whom were notable figures in the medical life of the country. Opposite the title page the author has a quotation from E. B. White, part of which says that "Whoever sets pen to paper writes of himself." Dr. Pugh has done so and has written an interesting book about a busy and successful life.

Among the most entertaining features are in the early chapters in which he tells of his boyhood in the Blue Ridge country of Virginia. His story of rural life there at the turn of the century is told with veracity and considerable humor. The locality names, the Ragged Mountains and Jack's Hollow are typical of an earlier America and he mentions that as a boy he had driven an ox team. He saw service in the Marine Corps as a private and corporal in World War I. After the war he completed his medical course and entered the Navy as an assistant surgeon. Like all Gaul the author has divided his book into three parts and this first section up to the beginning of his naval career he has called "The Green Years."

The second part, "Heyday," covers his life as a medical officer in the Navy, except for the later years. He tells of his experiences in many parts of the world; his duty in World War II; and his work as a busy general surgeon. In the third and last part of the book appropriately named "Vintage Years," he describes himself as a bureaucrat and gives an account of the many problems and difficulties he faced as Deputy Chief of the Bureau of Medicine and Surgery, and then as Surgeon General. His term in the latter office included most of the period of the Korean conflict. He made many long trips, mostly by air, in connection with medical meetings and the inspection of naval medical installations in various parts of the world.

Among the features of the book are the carefully selected illustrations. The picture of the old family doctor is a real contribution to Americana. There are two photographs, placed one above the other on the same page, showing the author's family in 1914 and 42 years later with each of the eight persons seated in the same relative position. A picture taken in 1954 in Yokosuka, Japan, is one of which Dr. Pugh must be justifiably proud. It shows him with the sleeve stripes of a rear admiral placed beside the chevrons of his son, a young Marine Corps corporal, a position held by his father in World War I.

If one is looking for a good American biography to read he need look no further than this book for it will give pleasure to many readers. The typography and paper are excellent and the volume is handsomely bound in Navy blue and gold.—*LOUIS H. RODDIS, Capt., MC, USN, (Ret.)*

THE MANAGEMENT OF FRACTURES AND DISLOCATIONS, Volumes I and II, by *Anthony F. DePalma,* M. D. 960 pages; illustrated. W. B. Saunders Company, Philadelphia, Pa., 1959. Price $35 for set of two volumes.

The author's purpose in compiling this two-volume set is to provide "a comprehensive atlas of fractures and other joint injuries depicted in such a fashion that the essential characteristics of the lesions are well recognized and the detailed methods of reduction, immobilization and post reduction management are clearly visualized step by step." The first 125 pages are devoted to definitions and general principles. Then the fractures that occur in each region of the body are considered in turn in a concise, outline form with an accompanying line drawing showing the principal details. In almost every case only one method is discussed "in order to impart to the reader a crystal-clear, logical approach to the problem at hand and to eliminate any possible confusion." The illustrations are all line drawings. They provide clarity in illustrating a type of fracture or a technic of reduction but are sometimes deficient in portraying such conditions as an aneurysmal bone cyst, a giant cell tumor, and traumatic arthritis.

In a work in which the author states frankly that he is dogmatic in the interest of clarity, it is inevitable that each reader will find many points of disagreement. To cite examples, this reviewer does not believe that the routine treatment of displaced supracondylar fractures of the humerus in children by manipulation and immobilization in flexion is either safe or productive of good results when employed by those surgeons without extensive experience. Dunlop's lateral traction method which is much safer and more certain is discussed only under "Impending Volkmann's Contracture." Also Bryant's traction is advocated for displaced fractures of the shaft of the femur in children under 5 years of age, despite Nicholson's work showing serious circulatory complications in many over the age of 2 when this method is employed. There are a few inconsistencies as well. In discussing injuries to knee ligaments the author states that "in cases of complete rupture immediate surgical repair of involved ligaments is far superior to conservative measures" but in discussing those associated with tibial plateau fractures and knee dislocations he states that "injuries of ligaments are always amenable to conservative treatment and never require surgical repair." These comments should not detract from the over-all value of this work which reflects a vast amount of experience and effort in its preparation. Its greatest appeal will be to the medical student, intern or general practitioner who requires a reference in which it is easy to look up a specific fracture and rapidly obtain the salient details of its management. —*WILLIAM S. STRYKER, Capt., MC, USN*

LIPIDOSES. Diseases of the Intracellular Lipid Metabolism, 3d edition, revised and enlarged, by *Siegfried J. Thannhauser*, M. D., Ph. D., Hon. M. D., Universities of Freiburg, Munich, Dusseldorf. 600 pages; illustrated. Grune & Stratton, Inc., New York, N. Y., 1958. Price $19.75.

This exhaustive and scholarly treatise concerning a group of disease entities, many of which are not commonly encountered by the average physician, continues to stand as a monumental reference work. Since all aspects of this class of disorders are so thoroughly explored, this well-illustrated volume is perhaps of equal reference value to internists, pathologists, pediatricians and dermatologists alike. The author discusses the physiology and chemistry of lipid metabolism, hyperlipemia, xanthomatoses, Gaucher's disease, Niemann-Pick's disease and miscellaneous conditions such as infantile amaurotic idiocy and gargoylism. Each of these subjects is probed thoroughly to incorporate the most recently discovered facts and methods including the use of isotopes in ascertaining the fate of various substances. Dr. Thannhauser emphasizes the fact that the common denominator for all the lipidoses is an intracellular disturbance of lipid metabolism occurring within reticuloendothelial cells and histiocytes. Because of the widespread occurrence of these cells, this group of disorders is truly systemic in nature. In reviewing this volume one cannot help being impressed by the significant contribution Dr. Thannhauser and his co-workers have made to the understanding of this important group of diseases. Finally, it should be pointed out that the extensive bibliography of over 2,000 references is of importance to those who wish to pursue the finer points concerning the many entities described.

—*ROBERT J. WHIPPLE, Capt., MC, USN*

REVERSIBLE RENAL INSUFFICIENCY. Diagnosis and Treatment, by *Donald H. Atlas*, M. D., Ph. D., F. A. C. P., and *Peter Gaberman*, M. D. 231 pages. Williams & Wilkins Company, Baltimore, Md., 1958. Price $7.

The purpose of this excellent book, as stated in the preface, is to survey the entire field of renal insufficiency (in preference to the term renal failure) in the light of the authors' experiences in several hospitals in the Chicago area. There are 414 references listed, representing an extensive review of the large volume of literature up through 1956. These references are discussed throughout the book with the authors pointing out where they are or are not in agreement. Almost all the possible causes of acute and chronic renal insufficiency are discussed, some in greater detail than others. The section on calcium metabolism is particularly complete. Physicians will find this book a ready reference for diagnosis and treatment. A good working knowledge of renal physiology is needed because this subject is not covered in explanatory detail in many places. The book is easy to use because of the reference list and an adequate index. It is recommended for all physicians coming in contact frequently or infrequently with the many entities resulting in acute or chronic renal insufficiency.

—*PRINCE D. BEACH, Lt. Col., MC, USA*

GROWTH AND DEVELOPMENT OF CHILDREN, by *Ernest H. Watson*, M. D., and *George H. Lowrey*, M. D., 3d edition. 334 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1958. Price $7.75.

The physician will find the new edition of this manual well written, well thought out, and extremely useful—a volume that is not to be read hurriedly. The introduction is short but interesting. Heredity and environment receive adequate coverage and statistical material is presented where it would be useful. Fetal growth and development are handled well. The chapter on normal physical measurements is excellent and includes tables, grids, x-rays and photographs Considerable information is compressed into 30 pages on behavior and personality. The development of organs and systems is discussed thoroughly and many illustrations, tables and x-rays are provided to help the reader. A brief but useful chapter on osseous development includes x-rays and drawings. The chapter on the role of the endocrine glands in normal growth and development has been rewritten and is excellent. Energy metabolism and nutrition receive adequate space and a number of charts and graphs are provided. The chapter on facial growth and dentition is treated in excellent fashion. The reviewer would have liked more material in the chapter outlining abnormal growth. The more than 400 references are an indication of the authors' research on this subject. The frequent use of tables, graphs and charts throughout keeps the manual concise.—*MILTON KURZROK, Capt., MC, USA*

A Textbook in RORSCHACH TEST DIAGNOSIS, by *Ewald Bohm*, Ph. D. 322 pages. Grune & Stratton, Inc., New York, N. Y., 1958. Price $7.75.

The type, contents, index, and bibliography of this thoughtful addition to English source books on the Rorschach test are all comfortable to use. The translation is easily readable, if occasionally a trifle heavy. The author makes some relatively extravagant claims for the Rorschach test in the first chapter, but proceeds logically to state his reasons and evidence. The philosophic and clinical bases are so gently, but thoroughly explored that the original statements begin to appear quite reasonable. Psychoanalytical in approach, the author reasons cautiously, defining the ground well and remaining clearly related to clinical material. The oft-repeated error of putting faith in the "instrument" instead of the operator is brought to the reader's attention. That this, or any test, can be only as good as the individual applying it is a fact often lost sight of in our blind worship of the golden calf of clinical tests, be they laboratory or psychological. It is necessary in Rorschach test exposition to explore clinical areas and some of the most interesting portions of the book were written as "background." Of special interest to psychiatrists is the short discussion of the difference in the psycbe of adults and children (page 200) and the chapter on diagnostic groups (page 210). Anyone who has occasion to apply Rorschach test knowledge will find this book highly useful, both as a source book and as a technical reference.

—*PAUL F. EGGERTSEN, Lt. Col., USAF (MC)*

EMOTIONAL PROBLEMS OF CHILDHOOD, edited by *Samuel Liebman,* M. D. 176 pages. The J. B. Lippincott Company, Philadelphia, Pa., 1958. Price $5.

This volume, the fourth of a series of books based on lectures given at the North Shore Hospital in Winnetka, Illinois, is especially designed to handle emotional problems in childhood. It is composed of nine chapters, each dealing with a different aspect of behaviorism and by different contributors. Excellent bibliographies are presented at the end of each chapter. The book was written primarily for the nonpsychiatric practitioner engaged in caring for children. It covers early emotional problems such as the psychologic aspects of pregnancy, the first parent-child relationships, difficulties in feeding, sleeping, locomotion and speech. Several chapters are devoted to the prepubescent and pubescent period, with particular emphasis on social maladjustment, behavior problems and the juvenile delinquent. The chapter dealing with the management of neuroses of adolescence is exceptionally well presented, as is the one describing the physically handicapped child and his emotional problems, a subject too frequently neglected or overlooked. Each author stresses and reaffirms that early management of the budding emotional problems, in most cases, will prevent them from becoming deeply rooted and will tend to prevent the occurrence of more serious psychologic problems in later life. This is an interesting, readable, informative book, recommended to those physicians caring for the pediatric age group.—*ERNST R. MOELLER, Capt., MC, USN*

CLINICAL OBSTETRICS AND GYNECOLOGY, Vol. 1, No. 4. Dec. 1958. A quarterly book series. Symposium on Operative Obstetrics, edited by *J. Robert Willson,* M. D., and Symposium on Genital Cancer, edited by *Daniel G. Morton,* M. D. 1138 pages; illustrated. Paul B. Hoeber, Inc., New York, N. Y., 1958. Price $18 per year-subscription of 4 issues.

The book is divided into two sections; the first is devoted to discussion of 11 different facets of operative obstetrics and the second to five different facets of genital cancer. The various subjects are discussed by separate authors who confine their efforts to that particular subject in detail and each is an authority in the field of obstetrics and gynecology. The discussions are particularly well organized and edited. They furnish a correlation between latest literature reports pertaining to this phase of obstetrics and gynecology, and the clinical side of the picture. Each article is condensed into a practical, readable reference for the busy clinician. They offer a condensed, well-outlined approach for the resident to study during his days of training. The chapters on therapy of genital cancer are outstanding in their clarity and organization. One, entitled "Obstetrical Injuries and Trauma," offers a common-sense approach not found in many wordy textbooks. Two others, "Management of Dystocia" and "Forceps Deliveries," should be required reading for all residents. This is one of four volumes that is worthy of careful reading for everyone working in the field of obstetrics and gynecology. It is an up-to-date, well written, worthwhile publication. —*ROY W. TANDY, Sr., Capt., MC, USN*

PRINCIPLES OF OPHTHALMOSCOPY, by *John K. Erbaugh*, M. D. 60 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1958. Price $5.50.

The author of this small volume has established a protocol, or technic, for performing an ophthalmoscopic examination of the eye so that important details will not be missed. He also presents a method to record the observations in such a manner that they support the findings or diagnosis. The format of the book is excellent and the physics and technics of ophthalmoscopy are described fully. The examination is conducted on an anatomically organized, systematic manner. The normal and pathologic findings of the ocular media, optic disk, vessels and retina, are described fully and illustrated by drawings and photographs, with many of the latter in color. This book is of practical value to senior medical students, general practitioners, internists, and neurologists because it emphasizes the vast amount of information that is readily available from examination of the eyes, and explains how to gather and use it for the patient's benefit in terms of diagnosis, prognosis and treatment.—*AUSTIN LOWREY, Jr., Col., MC, USA*

GYNECOLOGIC RADIOGRAPHY, by *Jean Dalsace*, M. D., and *J. Garcia-Calderon*, M. D., with a chapter on Radiography of the Breast, by *Charles M. Gros*, M. D., and *Robert Sigrist*, M. D. 188 pages; illustrated. Paul B. Hoeber, Inc., New York, N. Y. 1959. Price $8.

This small volume contains about three hundred and forty photographs depicting the radiographic appearance of the cervix, uterus, and fallopian tubes while the seat of inflammation, neoplasia, degenerative diseases, and congenital anomalies. All the reproductions are excellent and are accompanied by brief descriptive captions. Such an atlas is invaluable for the busy radiologist, not too familiar with the radiographic findings in certain diseases of the female breast and pelvis, and is recommended to every gynecologist for ready reference. It is the opinion of this reviewer that many of the gynecologic conditions described in the text can be diagnosed much more simply and accurately without resorting to the utilization of roentgen rays and contrast media. Likewise, I believe that the instillation of a foreign substance into a pregnant uterus for diagnostic purposes can be dangerous as can the attempt to diagnose a corpus or cervical cancer with any kind of contrast media as recommended in the text. The authors undoubtedly reflect the continental approach to the diagnosis and treatment of certain disease entities. They apparently do not fear the possible ill effects from repeated exposure to gamma irradiation nor do they share the American gynecologist's faith in the basic value of uterine curettage, and cervical and breast biopsy when searching out a malignant tumor in the female pelvis or breast. Irregardless of the philosophy of the authors this volume should be on the shelf of every radiologist for ready consultation and the contents of the text should be familiar to all gynecologists concerned with the problems of infertility.—*WILLIAM S. BAKER, Jr., Capt., MC, USN*

BLEEDING ESOPHAGEAL VARICES, by *Hirsch Robert Liebowitz*, B. S., M. D. with a Section on Treatment in collaboration with *Louis M. Rousselot*, M. D., M. S., Med. Sc. D., F. A. C. S. Foreword by *Allen O. Whipple*, M. D., F. A. C. S. 986 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $24.50.

This work is a timely and important contribution to the medical literature inasmuch as the mortality due to bleeding from a ruptured esophageal varix is greater than that associated with any other lesion of the digestive tract. The material contained in this volume is valuable to the general practitioner, internist, gastroenterologist and surgeon who might be called upon for the emergency control of the hemorrhage or a preventive surgical procedure. The pediatrician would be interested also in this book as the material is not restricted to cirrhosis but to all conditions which cause portal hypertension and esophageal varices. The foreword by Dr. Whipple emphasizes the importance of the contained material and the value of this book. All of the important literature concerning portal hypertension in esophageal varices with or without bleeding, and also the association of ascites, has been reviewed by the author, and added to his own personal experiences to arrive at the conclusions which he summarizes at the end of each presentation. There is much repetitious material from chapter to chapter, but I belive this leads to a better understanding of the subject material of each chapter. This is not an opinionated book but the result of consideration of the pro's and con's of all reports in the medical literature on portal hypertension and esophageal varices, with a summary of the author's interpretation of these conflicting reports. The pathogenesis of portal hypertension, the development of esophageal varices, intrahepatic structural changes, and hemodynamics within the portal system and their responses to medical therapy or to the many types of surgical procedures is discussed in great detail. Various collateral circulations are covered completely and lead to a better understanding of the pathogenesis of ascites and varices. The differential diagnosis of bleeding from an esophagogastric varix is clearly presented. Medical management is discussed in great detail, with specific recommendations for therapy including diagnostic procedures and dietary regime which are an asset to our understanding of the current medical therapeutic attitudes. The section on surgical management of portal hypertension and esophageal varices with or without hemorrhage is thorough and, includes detailed technics of the procedures. A bibliography concludes each chapter, and there is a complete index at the end of the book. Any physician, regardless of his specialty, who may see or treat patients in the category covered by this work should read this book in its entirety because it gives a better understanding of the current opinions of the pathogenesis, medical and surgical treatment of those patients who are in mortal danger from portal hypertension. It is recommended for all military medical libraries and as a reference book.

—EDWARD P. McLARNEY, Capt., MC, USN

New Books

Books received by the *U. S. Armed Forces Medical Journal* are listed in this department for the information of readers, and as acknowledgement and appreciation of their receipt from the publishers. Those of greatest interest will be selected for review in a subsequent number of the *Journal.*

THE MANAGEMENT OF ORAL DISEASE, A Treatise on the Recognition, Identification, and Treatment of Diseases of the Oral Regions, by *Joseph L. Bernier,* D. D. S., M. S., F. D. S., R. C. S. (Eng.), Colonel, Dental Corps, United States Army. 2d edition. 875 pages; illustrated. The C. V. Mosby Company, St. Louis, Mo., 1959. Price $15.

DIFFERENTIAL TREATMENT AND PROGNOSIS IN SCHIZOPHRENIA, by *Robert D. Wirt,* Ph. D., and *Werner Simon,* M. D., with six contributors. 198 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $6.50.

PRACTICAL ORAL SURGERY, by *Henry B. Clark, Jr.,* M. D., D. D. S. 2d edition; thoroughly revised. 569 pages; illustrated. Lea & Febiger, Philadelphia, Pa., 1959. Price $9.50.

X-RAY AND RADIUM IN DERMATOLOGY, by *Bernard A. Wansker,* M. D. 114 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $5.

SURGERY OF THE COLON, by *E. S. R. Hughes,* M. D., M. S. (Melb.), F. R. C. S. (Eng.), F. R. A. C. S. 415 pages; illustrated. The Williams & Wilkins Co., Baltimore, Md., 1959. Price $12.50.

CORONARY HEART DISEASE, by *John William Gofman,* M. D., Ph. D. 353 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $8.

THE ESSENTIALS OF ROENTGEN INTERPRETATION, by *Lester W. Paul,* M. D., and *John H. Juhl,* M. D. 839 pages; illustrated. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, N. Y., 1959. Price $25.

SQUINT AND ALLIED CONDITIONS, by *George P. Guibor,* M. D., D. D. S. 356 pages; illustrated. Grune & Stratton, Inc., New York, N. Y., 1959. Price $11.50.

VOCATIONAL REHABILITATION FOR THE PHYSICALLY HANDICAPPED, by *Louise M. Neuschutz,* with forewords by *Winthrop M. Phelps,* M. D., and *K. Vernon Banta.* 136 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $5.75.

HANDBOOK OF DIET THERAPY, by *Dorothea Turner.* 3d edition. 222 pages. The University of Chicago Press, Chicago, Ill., 1959. Price $5.

DEVELOPMENTAL CYTOLOGY, edited by *Dorothea Rudnik,* with 10 contributors. 215 pages; illustrated. The Ronald Press Company, New York, N. Y., 1959. Price $7.

INSULIN TREATMENT IN PSYCHIATRY, Proceedings of the International Conference on the Insulin Treatment in Psychiatry held at the New York Academy of Medicine, 24 to 25 October 1958, edited by *Max Rinkel,* M. D., and *Harold E. Himwich,* M. D. 386 pages. Philosophical Library, New York, N. Y., 1959. Price $5.

A GUIDE TO ORTHOPAEDICS, by *T. T. Stamm,* M. B., B. S., F. R. C. S. 115 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $3.

THE YEAR BOOK OF ORTHOPEDICS AND TRAUMATIC SURGERY (1958-1959 Year Book Series), edited by *Edward L. Compere,* M. D., F. A. C. S., F. I. C. S., with a section on Plastic Surgery, edited by *Neal Owens,* M. D., F. A. C. S., F. I. C. S. 445 pages; illustrated. The Year Book Publishers, Inc., Chicago, Ill., 1959. Price $7.50.

HYPERTENSIVE DISEASE, Diagnosis and Treatment, by *Sibley W. Hoobler,* M. D. 353 pages; illustrated. Paul B. Hoeber, Inc., Medical Book Department of Harper & Brothers, New York, N. Y., 1959. Price $7.50.

A PRIMER OF WATER, ELECTROLYTE AND ACID-BASE SYNDROMES, by *Emanuel Goldberger,* M. D., F. A. C. P. 322 pages. Lea & Febiger, Philadelphia, Pa., 1959. Price $6.

THE PRACTICAL EVALUATION OF SURGICAL HEART DISEASE, The Glover Clinic. Written and compiled by *Robert G. Trout,* M. D.: edited by *Robert P. Glover,* M. D.; medical illustrator, *Joseph Sunner.* Heart sounds recorded by *J. Scott Butterworth,* M. D. 132 pages; illustrated. Record of heart sounds enclosed. The Blakiston Division, McGraw-Hill Book Company, Inc., New York, N. Y., 1959. Price $10.

MODERN DERMATOLOGIC THERAPY, edited by *Thomas H. Sternberg,* M. D., and *Victor D. Newcomer,* M. D. 520 pages; illustrated. The Blakiston Division, McGraw-Hill Book Company, Inc., New York, N. Y., 1959. Price $10.

PRINCIPLES OF BIOCHEMISTRY, by *Abraham White,* Ph. D.; *Philip Handler,* Ph. D.; *Emil L. Smith,* Ph. D.; and *DeWitt Stetten, Jr.,* M. D., Ph. D. 2d edition. 1,149 pages; illustrated. The Blakiston Division, McGraw-Hill Book Company, Inc., New York, N. Y., 1959. Price $15.

AUTOGENIC TRAINING, A Psychophysiologic Approach in Psychotherapy, by *Johannes H. Schultz,* M. D., and *Wolfgang Luthe,* M. D. 289 pages; illustrated. Grune & Stratton, Inc., New York, N. Y., 1959. Price $9.50.

DYNAMIC PSYCHOPATHOLOGY IN CHILDHOOD, edited by *Lucie Jessner,* M. D., and *Eleanor Pavenstedt,* M. D., with 15 contributors. 315 pages. Grune & Stratton, Inc., New York, N. Y., 1959. Price $8.75.

COMMUNITY MENTAL HEALTH, A School-Centered Program and a Group Discussion Program, by *Margaret C. L. Gildea,* M. D. 169 pages. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $5.

TRIGEMINAL NEURALGIA, Its History and Treatment, by *Byron Stookey,* A. M., M. D., and *Joseph Ransohoff,* M. D. 366 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $10.75.

PERIPHERAL VASCULAR DISEASES, An Objective Approach, by *Travis Winsor,* M. D., F. A. C. P., with a foreword by *Burrell O. Raulston,* M. D. 845 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $16.50.

THE TREATMENT AND PREVENTION OF READING PROBLEMS, (The Neuro-psychological Approach), by *Carl H. Delacato,* Ed. D. 122 pages; illustrated. Charles C Thomas, Publisher, Springfield, Ill., 1959. Price $4.50.

CONDUCTION, INFILTRATION AND GENERAL ANESTHESIA IN DENTISTRY, by the late *Mendel Nevin,* D. D. S., and *Marshall I. Nevin,* M. D., F. C. C. P. General Anesthesia section by *Julious Roy Bourgoyne,* B. S., D. D. S. 6th edition. 392 pages; illustrated with engravings and large trigeminal chart. Dental Items of Interest Publishing Co., Inc., Brooklyn, N. Y., 1959.

PROGRESS IN PSYCHOTHERAPY, Vol. IV., Social Psychotherapy, edited by *Jules H. Masserman,* M. D., and *J. L. Moreno,* M. D. 561 pages. Grune & Stratton, Inc., New York, N. Y., 1959. Price $8.75.

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